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A STUDY IN MINUTE LIFE.

By HENRY J. SLACK, F.G.S., F.R.M.S.

No. I.

THE interest to be derived from the use of the microscope soon passes away unless it is accompanied with some scientific thinking about what is seen. With the help of such thinking, there is no end to the combinations of amusement and instruction that was previously gained. Suppose, for example, one of the oldest experiments is made, that of putting a little wisp of hay into a vessel of water, and noticing what happens. In a tolerably warm place, many hours will not pass before a sort of skin forms on the surface of the water, and after this soon appear a swarm of moving creatures. M. Pouchet called this skin a proliferous pellicle, and ascribed to it a kind of maternal power in generating the animalcules that come after it. This notion he connected with a theory of creation in which at some imaginary periods of great cataclysms and catastrophes, prodigious putrefactions and decompositions occurred, and out of the seething mass arose monstrous forms.

Gorgons, hydras, and chimeras dire.

The fact, however, is, that the quantity of the decomposing material has no direct action upon the kind of life that appears, and that a great many creatures neither want putrefaction or its products, but are injured by the process. The chemical changes that occur in fermentations, like that of sugar into alcohol and carbonic acid, or in decompositions that by no means charm the nose with pleasant smells, are caused or promoted by living organisms: in the case of yeast-cells, resembling little bladders, and in other cases, minute rods or wriggling spirals. It is not, however, with these micro-ferments that we are now concerned, but with higher forms that are sure to be found injurious, but which can be well developed in water that contains their appropriate nutriment, but remains sweet.

It is best, when varieties of minute life are required, to operate on a tolerably large scale, say a good handful of hay in a gallon of water, but a pinch of it in a tumbler is sure to yield a good harvest, and germs of various organisms are so widely and commonly distributed that success may be obtained with a grain of chopped hay in a quarter of an ounce of water. In such small experiments a two-drachm vial answers very well. In a shallow vessel the water dries up too quickly. The student need not at first trouble himself with the particle or with any object not big enough to be easily seen with an inch power, or at most a half-inch. An accurate stock of general ideas and broad principles should be acquired before attention is directed to the most minute structures. Before taking much trouble to identify the various objects and learn their names, it will be well to notice certain peculiarities of structure. A crowd of little restless creatures is sure to be seen in the infusion mentioned, and their movements are produced by hair-like projections, called cilia, no other external instrument being visible. Their runnings to and fro are incessant. Whenever they are looked at, by day or night, their activity is striking, and until they become weak or dying their pace is maintained. While the cilia are in quick movement, it is impossible to see exactly what they are and what they do. If, however, a good-sized specimen of any ciliated object is allowed to get nearly dry, and consequently enfeebled, the motion of the organ can be plainly discerned. For our purpose a little drop of water containing some of the creatures should be placed on a glass slide, covered with thin glass, and the object watched under the microscope until, from vigorous movements while there is plenty of water, they grow languid and slow as evaporation from the edges of the covering glass lessens the supply. A cilian is then observed to move much in the way we can imitate with an elastic stick about a yard long, and having an impulse given to it by sharp turns of the wrist. There is a wave motion from the bottom to the top of the cilian like that which can be made to agitate the flexible stick. As cilia are usually very numerous and close together in the sort of objects under our notice, it is evident that if they did not move rhythmically and in a thoroughly orderly way, they would be in frequent collision. This would be very awkward if the purpose to be served were only, as with many species, the production of water currents to bring them food, and it would be quite inconsistent with the rowing action required for locomotion. A common species is very conspicuous in the *Paramecium aurelia*, an oblong little creature ranging in size from a little more or less than 1-100th of an inch in length. It possesses longitudinal rows of cilia; Ehrenberg found some fine specimens with as many as fifty-two of these rows, each containing from sixty to seventy cilia, making 3,640 in in all. Each cilian rises from a minute knob, which, though not containing positive muscular structure, acts like a nicely-arranged combination of muscles. There is again no nerve cell, but the whole group of organs is made to work harmoniously by some undiscoverable, but no doubt most methodically-arranged, groups of molecules, which receive impressions from their surroundings, and stimulate the contractions and expansions by which the movements are produced. If we were furnished with three or four thousand limbs whose use and movements had to be divided by our intelligence and our will, we might be a long time learning how to get on without grievous mistakes. In the case of the infusoria, we cannot imagine anything like human volition or purpose, but one as high in the ranks of life as a Paramecium has to use its army of external organs for these purposes, to produce currents of water so that fresh streams continually reach its surface and provide amply for its respiration, so that the minute objects that serve for its food may come within reach of its mouth and be swallowed, and that the cilia particularly engaged

in moving it about shall not be hindered by other cilia pulling in wrong directions.

The tendency of matter in motion to become rhythmical is well known to all physicists. Air readily vibrates in musical pulsations; the waterfall makes its musical chord, and the pendulums of adjacent clocks are said to conform their beats. All such considerations are very interesting, and they enable us to find resemblances of analysis between the action of our ciliated infusoria and a host of other rhythmical and orderly processes. Our explanations, however, soon come to an end, and wonder engulphs us where actual knowledge fails.

In another paper we will endeavour to obtain some more ideas of natural history and physiology from our hay infusion. Now, we will only add that cilia are found in all the vertebrate animals, and in most of the invertebrates, though not in crabs, spiders, and insects. Man has them in many places springing from epithelium cells, in such living membranes as those of the larynx, trachea, and bronchial tubes. They do much in their situations to keep back dirt particles, but their success is far from perfect. Town air, especially foggy days, makes the human being too much of a dirt-bin to be consistent with health.

THE CRYSTAL PALACE ELECTRICAL EXHIBITION.

Fourth Notice.

VERY great progress has been made during the past week in all departments, more especially in that of electric lighting. Siemens, Swan, Hawkes, Gerard, Jablochkoff, &c., are all at work.

The Palace has never before looked so attractive, and even the gallery, with its quota of light, is very pleasant, both to the visitor and the exhibitor. One of the collections which visitors should not fail to inspect is that in the north nave, exhibited by the War Office. The most attractive feature of the exhibits is the destructive apparatus, torpedoes, &c., technically termed "mines," a name which is perhaps more innocent or less startling to tender nerves, than that by which they are more generally known.

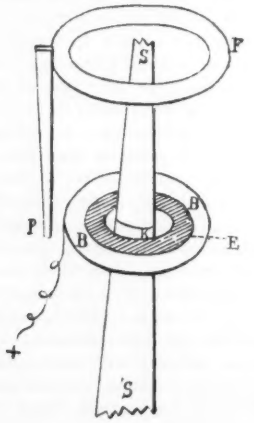

Fig. 1.

They are exhibited in various forms and sizes, but, of course, none of them are charged. One, made to contain 100 lb. of gun-cotton, is suspended from the roof, and represents the manner in which it would be moored so as to float near the surface of the water. Mines, however, are generally of a larger size, and are placed on the river-bed or sea-bottom, where the depth does not exceed 60 feet. In deeper water they are suspended by a buoy (containing the circuit-closing apparatus, to be described further on) at a depth of 50 feet. Some of the specimens exhibited are constructed to hold a charge of 500 lb. of gun-cotton, which, on exploding, automatically or otherwise, at the above-mentioned depth, sends into the air a column of water 80 feet in diameter and 150 feet high.

Fig. 1 illustrates what is known as the "circuit-closing apparatus." S S′ is a steel rod rigidly fixed at the bottom, and weighted at the thin upper end, which is free. A small collar of brass (K) is attached to the rod at about the middle of its length. Round K is a ring of ebonite (E), to insulate another brass ring (B) from the rest of the apparatus. The brass ring (F) is a portion of the framework, and is metallically connected to the flat brass spring P. The wire from one end of the battery (about four Leclanché cells) on shore is connected to the brass ring B. When a vessel strikes the buoy or mine, as the case may be, the steel rod oscillates sufficiently to make contact between the ring B and the spring P. The current will then pass from B into P, and thence through the framework—the electrical circuit being completed through the water and earth. So far, however, no more damage is done than to ring a bell on

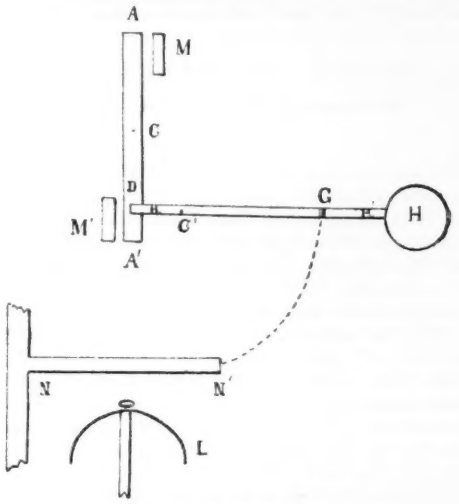

Fig. 2.

shore. Fig. 2 shows how this is done. MM′ are extensions (known as pole pieces) of the soft iron core of an electro-magnet. The current which is produced by the impact of a vessel on the buoy passes through the electro-magnet, and in consequence M and M′ attract the piece of soft iron, AA′, which is pivotted at C, so that both M and M′ tend to draw AA in the same direction. D is a pin on AA′, RR′ is a lever, with the hammer, H, at one end, and pivoted at C′, so that when AA′ is drawn away, D allows H to fall, and strike the bell, L. This gives notice to the officer of the approach of a vessel, which he may then blow up. The blowing-up, however, is very easily made automatic. NN′ (fig. 2) is a piece of brass, with a slit wide enough to allow the hammer-lever in falling to enter and make contact at G. This completes the electrical circuit for firing the mine. Of course, all this is but the work of an instant.

The fuze is represented in fig. 3. B is the beechwood cup, and W W are the extremities of a piece of fine

platinum wire stretched across the cup. When the firing circuit is completed, the current enters by means of a wire joined to W, and, passing this, the platinum leaves by another wire joined to W'. Fifty to sixty Leclanché cells are used, and make the platinum red-hot, thereby igniting a small quantity of gun-cotton wrapped round it, the flame from which, consuming a thin paper cover P P', enters the

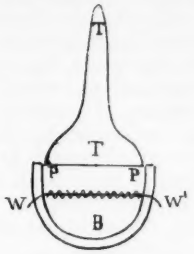

Fig. 3.

detonating tube T T, containing fulminating mercury. The explosion of this is followed by the explosion of the mine. When the mine is fired by hand, a key, somewhat similar to a Morse telegraph key, is used. Normally there is a piece of ebonite switched into the space between the contact points, so that the mine may not be accidentally fired. The whole collection displays the state of perfection to which we have attained in the art of wholesale homicide.

"Field Telegraph Equipment," "Signalling Apparatus," and "R.E. Field Company Equipment," are all well represented, but our space will not permit a description this week. We can only say that everything gives one an impression of extreme compactness and efficiency, reflecting great credit on the War Office.

A new feature in the Exhibition is the delivery of a course of lectures by Professor Sylvanus Thompson. In the first he essayed to demonstrate what electricity is, and, after describing its production and effects, he said that the late Professor Clerk Maxwell regarded electricity as the motion of the ether of space, and that it was most probably in that direction we should have to look to discover the nature of electricity.

VENTILATION BY OPEN FIRE-PLACES.

By W. Mattieu Williams.

THE most stubborn of all errors are those which have been acquired by a sort of inheritance, which have passed dogmatically from father to son, or, still worse, from mother to daughter. They may become superstitions without having any theological character. The idea that the weather changes with the moon, that wind "keeps off the rain," are physical superstitions in all cases where they are blindly accepted and promulgated without any examination of evidence.

The idea that our open fireplaces are necessary for ventilation is one of these physical superstitions, which is producing an incalculable amount of physical mischief throughout Britain. A little rational reflection on the natural and necessary movements of our household atmospheres demonstrates at once that this dogma is not only baseless, but actually expresses the opposite of the truth. I think I shall be able to show in what follows that, 1st, they do no useful ventilation; and, 2nd, that they render systematic and really effective ventilation practically impossible.

Everybody knows that when air is heated it expands largely, becomes lighter, bulk for bulk, than other air of lower temperature; and, therefore, if two portions of air of unequal temperatures and free to move are in contact with each other, the colder will flow under the warmer, and push it upwards. This latter postulate must be kept distinctly in view, for the rising of warm air is too commonly regarded as due to some direct uprising activity or skyward affinity of its own, instead of being understood as an indirect result of gravitation. It is the downfalling of the cooler air that causes the uprising of the warmer.

Now, let us see what, in accordanee with the above-stated simple laws, must happen in an ordinary English apartment that is supplied, as usual, with one or more windows more or less leaky, and one or more doors in like condition, and a hole in the wall in which coal is burning in an iron cage immediately beneath a shaft that rises to the top of the house, the fire-hole itself having an extreme height of only 24 to 30 inches above the floor, all the chimney above this height being entirely closed. (I find by measurement that 24 inches is the usual height of the upper edge of the chimney opening of an ordinary "register" stove. Old farm-house fire-places are open to the mantel-piece.)

Now, what happens when a heap of coal is burning in this hole? Some of the heat—from 10 to 20 per cent., according to the construction of the grate—is radiated into the room, the rest is conveyed by an ascending current of air up the chimney. As this ascending current is rendered visible by the smoke entangled with it, no further demonstration of its existence is needed.

But how is it pushed up the chimney? Evidently by cooler air, that flows into the room from somewhere, and which cooler air must get under it in order to lift it. In ordinary rooms this supply of air is entirely dependent upon their defective construction—bad joinery; it enters only by the crevices surrounding the ill-fitting windows and doors, no specially-designed opening being made for it. Usually the chief inlet is the space under the door, through which pours a rivulet of cold air, that spreads out as a lake upon the floor. This may easily be proved by holding a lighted taper in front of the bottom door-chink when the windows and other door—if any—are closed, and the fire is burning briskly. At the same time more cold air is poured in at the top and the side spaces of the door and through the window chinks. The proportion of air entering by these depends upon the capacity of the bottom door-chink. If this is large enough it will do nearly all the work, otherwise every other possible leakage, including the key-hole, contributes.

But what is the path of the air which enters by these higher level openings? The answer to this is supplied at once by the fact that such air being colder than that of the room, it must fall immediately it enters. The rivulet under the door is thus supplemented by cascades pouring down from the top and sides of the door and the top and sides of the windows, all being tributaries to the lake of cold air covering the floor. The next question to be considered is, what is the depth of this lake? In this, as in every other such accumulation of either air or water, the level of the upper surface of the lake is determined by that of its outlet. The outlet in this case is the chimney hole, through which all the overflow pours upwards; and therefore, the surface of the flowing stratum of cold air corresponds with upper part of the chimney hole, or of the register, where register stoves are used.

Below this level there is abundant ventilation, above it

XUM

there is none. The cat that sits on the hearth-rug has an abundant supply of fresh air, and if we had tracheal breathing apertures all down the sides of our bodies, as caterpillars have, those on our lower extremities might enjoy the ventilation. If we squatted on the ground like savages something might be said of the fire-hole ventilator. But as we are addicted to sitting on chairs that raise our breathing apparatus considerably above the level of the top of the register, the maximum efficiency of the flow of cold air in the lake below is expressed by the prevalence of chilblains and rheumatism.*

The atmosphere in which our heads are immersed is practically stagnant; the radiations from the fire, plus the animal heat from our bodies, just warm it sufficiently to enable the cool entering air to push it upwards above the chimney outlet and the surface of the lower moving stratum, and to keep it there in a condition of stagnation.

If anybody doubts the correctness of this description, he has only to sit in an ordinary English room where a good fire is burning—the doors and windows closed, as usual—and then to blow a cloud by means of pipe, cigar, or by burning brown paper or otherwise, when the movements below and the stagnation above, which I have described, will be rendered visible. If there is nobody moving about to stir the air, and the experiment is fairly made, the level of the cool lake below will be distinctly shown by the clearing away of the smoke up to the level of the top of the register opening, towards which it may be seen to sweep. Above this, the smoke-wreaths will remain merely waving about, with slight movements due to the small inequalities of temperatures caused by the fraction of heat radiated into the room from the front of the fire. These movements are chiefly developed near the door and windows, where the above-mentioned cascades are falling, and against the walls and furniture where feeble convection currents are rising, due to the radiant heat absorbed by their surfaces. The stagnation is the most complete about the middle of the room where there is the greatest bulk of vacant air space.

When the inlet under the door is of considerable dimensions, there may be some escape of warmer upper air at the top of the windows, if their fitting is correspondingly defective. These, however, are mere accidents; they are not a part of the vaunted chimney-hole ventilation, but interferences with it.

There is another experiment that illustrates the absence of ventilation in such rooms where gas is burning. It is that of suspending a canary in a cage near the roof. But this is cruel; it kills the bird. It would be a more satisfactory experiment to substitute for the canary-bird any wingless biped who, after reading the above, still maintains that our fire-holes are effective ventilators.

Not only are the fire-holes worthless and mischievous ventilators themselves, but they render efficient ventilation by other means practically impossible. The "Arnott's ventilator" that we sometimes see applied to the upper part of chimneys is marred in its action by the greedy "draught" below.

The tall chimney-shaft with a fire burning immediately below it dominates all the atmospheric movement in the house, unless another and more powerful upcast-shaft be somewhere else in communication with the apartments. But in this case the original or ordinary chimney would be converted into a downcast-shaft pouring air downwards into the room, instead of carrying it away upwards. I need not describe the sort of ventilation thus obtainable while the fire is burning and smoking.

Effective sanitary ventilation should supply gentle and uniformly-diffused currents of air of moderate and equal temperature throughout the house. We talk a great deal about the climate here and the climate there, and when we grow old and can afford it we move to Bournemouth, Torquay, Mentone, Nice, Algiers, &c., for better climates, forgetting all the while that the climate in which we practically live is not that out-of-doors, but the indoor climate of our dwellings, the which, in a properly-constructed house, may be regulated to correspond to that of any latitude we may choose. I maintain that the very first step towards the best approximation to this which is attainable in our existing houses, is to brick up, cement up, or otherwise completely stop up, all our existing fire-holes and abolish all our existing fires.

But what next? The reply to this will demand the whole of another short essay.

* Since the above was written, a correspondent in Paris tells me that a caricature exists, representing a Frenchman enjoying an open fire by standing on his head in the middle of the room.

THE ELECTRIC TELEGRAPH.

By W. Lynd.

THE WIRES AND INSULATORS.

THE manner in which a telegraph line is carried from station to station must be familiar to all. The conducting wires are passed through a bath of liquid zinc, by which process they receive a coat of that metal. Zinc being easily oxidised, is by the action of the atmosphere converted into oxide of zinc, and protects the iron from the influence of moisture. The wires are suspended by earthenware or glass supports called insulators, fixed upon wooden posts, at intervals of about sixty yards. As electricity has always a tendency to pass by the shortest route possible to the earth, it will easily be understood that if the wires were allowed to rest upon the wooden poles, the current would make its escape before it reached the receiving station. Wood, when seasoned with tar, is a very poor insulator. There must be some good non-conducting substance between the wire and the post. There are many forms of insulators. Glass offers the greatest resistance to an electric current of any known material, but electricians object to it on account of its hygroscopic properties—a film of moisture collects upon glass in nearly all states of the weather. On some lines ebonite is used, but there are objections even to that excellent non-conducting substance; rain wets it easily, and its surface soon becomes dirty and spongy. Brown earthenware insulators are the most common in this country; the glaze does not crack, and although they have not so great a resistance as glass, they are, on account of their cheapness and durability, used in preference to any other kind of non-conducting supports. In spite of all precautions, however, electricity finds a means of escape from the best insulated lines. In wet weather the leakage is sometimes so great that the signals on the recording instruments at receiving stations are almost unintelligible. The steel indicator of a single needle telegraph apparatus should strike against two ivory pivots on the dial plate, in order that the beats may be distinctly understood, but I have had to read off messages in bad weather when the current was so weak that the needle did not touch the pivots at all, and half the letters had to be guessed. In rainy weather, coats of moisture collect upon the wire, insulator, and post, and as a natural result the electricity flows to earth. If there is only a little loss at each post, the current on a long line is

soon weakened, and it is not unusual in stormy weather to put on additional battery power to compensate for the loss.

The electric conductivity of moist air has been a subject of dispute; some electricians have held that humid air acts as a conductor of electricity; and others have maintained that it does not. Recent experiments of M. Marangoni support the latter theory very decidedly, for he finds that a Leyden jar, heated so as to prevent condensation of moisture on its glass walls, and thus arrest surface conduction, gives a long spark as in the driest air. When, however, the precaution of heating the walls of the jar is not taken, the moisture condenses on the latter, and, forming a thin film of water, causes a silent discharge, which might be mistaken for a slow discharge through the conducting air. It follows from these experiments that the loss of electricity on telegraph lines is wholly due to surface conduction over the wet and dirty insulators, or leakage along entangled threads and branches of trees, at particular points, and not to a general discharge into the saturated air.

Lightning, or atmospheric electricity, is occasionally attracted to the wires, and passes along them, disturbing the indications of the instruments. Telegraphists are always exposed to danger during a thunderstorm. In the summer of 1859, a youth employed in the telegraph department of one of our principal railways was seriously injured by the physiological effects of an electric shock, received while he was sending a message on the double-needle instrument. A storm was raging at the time, and the clerk did not take the precaution to avoid touching the metallic parts of the instrument. At that period, the many ingenious contrivances for diverting the lightning now in use had not been thought of. I have known the fine silk-covered wires used in certain parts of the needle telegraphs fused into an amorphous mass. When the currents of atmospheric electricity were not so intense, they usually demagnetised the needles, causing them to deflect the reverse way.

The Aurora Borealis or Northern Lights will sometimes cause a disturbance in telegraphic communication. The long lines and cables are more liable to be affected by the Aurora. There was a disturbance of this kind from Aug. 11 to 14, 1880. According to the report of Privy Councillor Ludewig, of the Central Telegraph Department, Berlin, it seems to have manifested itself throughout the greater portion of the northern section of the Eastern hemisphere, sending off, however, a southerly stream in the direction of Mozambique, which reached to Natal. It does not appear that the western continent was affected. The general features of the disturbance consisted of manifestations of the presence of strange currents (earth currents as they are called) of fluctuating intensity, the durations and fluctuations varying in different localities, and the direction of the currents changing frequently. This last feature would seem to indicate a movement of revolution, or at least of approach and recess, with regard to some line or point. These disturbances were traceable alike in underground lines and in lines carried through the open air. In Germany all the longer lines were very much disturbed, in the ways mentioned, on Aug. 12, from noon till late at night. The interruptions frequently involved the omission of several signs, or even words, and in the Morse apparatus, continuous strokes appeared on the paper.

There are other causes of disturbance to which telegraph lines are liable. Kite-tails entangled in the wires will, if a shower of rain comes on, cause contact: the electricity will flow from one wire to the other, so that a message, say, from London to Birmingham, may pass through three or four different circuits, and give rise to provoking confusion and delay. I have seen the dead body of a large bird lying across the wires of a railway telegraph line.

Apropos of the feathered tribe, some interesting facts were recently brought out in a paper by M. C. Nielsen, of Christiania, on the impression produced upon animals by the resonance of the vibration of telegraph wires. It is found that the black-and-green woodpeckers, for example, which hunt for insects in the bark and in the heart of decaying trees, often peck inside the circular hole made transversely through telegraph posts, generally near the top. The phenomenon is attributed to the resonance produced in the post by the vibration of the wire, which the bird mistakes as the results of the operations of worms and insects in the interior of the post. Everyone knows the fondness of bears for honey. It has been noticed that in mountainous districts they seem to mistake the vibratory sound of the telegraph wires for the grateful humming of bees, and, rushing to the posts, look about for the hives. Not finding it on the post, they scatter the stones at its base, which help to support it, and, disappointed in their search, give the post a parting pat with their paw, thus showing their determination, at least, to kill any bees that may be about. Indisputable traces of bears about prostrate posts and scattered stones prove that this really happens. With regard to wolves, again, M. Nielsen states that when a vote was asked for the first great telegraph lines, a member of the Storthing said that, although his district had no direct interest in the line proposed, he would give his vote in its favour, because he knew the lines would drive the wolves from the districts through which they passed. It is well known that to keep off the ravages of hungry wolves, in winter, the farmers of Norway set up poles connected together by a line or rope, under which the wolves would not dare to pass. "And it is a fact," M. Nielsen states, "that when, twenty or more years ago, telegraph lines were carried over the mountains and along the valleys, the wolves totally disappeared, and a specimen is now a rarity."

WATER-CARRYING TORTOISES.—At a recent meeting of the San Francisco Academy of Sciences a fine specimen of the desert land tortoise, captured at Cajon Pass, San Bernardino County, was shown, and Professor E. T. Cox related some curious circumstances in connection with it. This tortoise, which is as large as a good-sized bucket, is a native of the arid regions of California and Arizona. On one being dissected, it was found that it carried on each side a membrane, attached to the inner portion of the shell, in which was about a pint of clear water, the whole amount being about a quart. Professor Cox was of opinion that the water was derived from the secretions of the giant barrel cactus, on which the tortoise feeds. This cactus contains a great deal of water. The tortoise is found in sections of the country where there is no water, and where there is no vegetation but the cactus. A traveller suffering from thirst could, in an emergency, supply himself with water by killing a tortoise. They are highly prized by Mexicans, who make from them a delicious soup. They are oftentimes attacked by foes, both for their water and also for their flesh. They are overcome by the foxes, and killed by being dragged for miles over the country at a pretty rapid pace. Mr. Redding afterwards stated that he was on the Gallapagos Islands in 1849, when he assisted in capturing 92 land tortoises, varying in weight from 450 lb. to 600 lb. each. These they brought to San Francisco, where they sold them for more money than the whole of the ship's cargo of lumber made. They were two months on board, yet they neither ate nor drank anything, though food and water were offered them. When killed, however, considerable quantities of water were found in each of them. They lived on the high lava rocks of the islands, where there are no springs or streams, and the only dependence of animal life for water is necessarily upon the irregular and uncertain rain showers. These were of a different species from the one shown. It was generally admitted that it would be useful if the habits and peculiarities of these animals could be noted, and some trustworthy information as to how they collect and secrete their water obtained. —*Times.*

XUM

NIGHTS WITH A THREE-INCH TELESCOPE.

By "A Fellow of the Royal Astronomical Society."

OUR first object to-night shall be that beautiful and familiar double-star α Geminorum, or Castor (Map, p. 298). This, with the instrument we are employing, we shall find to be a perfectly easy object; in fact, were the young observer furnished with the means of accurately directing his telescope, Castor might be seen double in bright twilight—or even in broad daylight. Its telescopic aspect, with a power of 120, is shown in Fig. 20.

Fig. 20.—Castor.

δ Geminorum is another star which will repay examination. It will be found in the Map on p. 298. The small, purplish companion will be found above the principal star, and just to the left of the lower circle passing through it. κ (below Pollux in the same map) is a difficult and delicate pair, requiring a first-class instrument and acute vision to see the comes at all. 38 in this constellation (bottom square but one in the left-hand corner of Zodiacal Map, p. 225), though difficult, is a decidedly easier object than κ. In both these stars the contrasted colours of the companions are very fine. Many other objects will be found marked D and B in the map; but, being invisible to the naked eye, they are by no means easy to pick up without an equatorial mounting.

Cancri is not a constellation containing many objects of interest within the power of a three-inch telescope. Nevertheless the student will see ζ as a double star (it is really triple). ϕ^2 is another object, approximately as easy to see as ζ. 66 Cancri is decidedly more difficult; for, although the components are about the same distance apart as those of ϕ^2, their considerable inequality makes the comes look small by contrast. Fig. 21 exhibits it as seen when best defined with a power of 160.

Fig. 21.—66 Cancri.

ι Cancri is chiefly interesting from the contrasted colours of its components. They are, relatively, very wide apart. Should the observer possess a day eye-piece, he may put it on to scrutinise the Præsepe with. At all events, he must use the lowest power he has. The same eye-piece may be retained to look at another cluster, 67 Messier, somewhat to the west, or right, of α in the sky.

And now we arrive at a star which, while scarcely affording a crucial test, yet requires a very good eye and instrument to see it well and cleanly separated. We refer to the familiar one, γ Leonis (Map, p. 298), which, with a power of 160, should present the appearance indicated in Fig. 22.

A more difficult object, and one which will severely tax the powers, both optical and visual, of the observer, is ι Leonis (Map, p. 298). 54 Leonis is a charming object. There are a very great many small pairs in Leo; but the remarks which we have made above in connection with telescopic stars in Gemini are equally applicable here. If the student will fish about the apex of an equilateral triangle, whereof α and γ Leonis form the extremities of the base (to the left, or east, of the line joining them) with the lowest power at his disposal, he will find himself in a region rich in nebulæ.

Fig. 22.—γ Leonis.

Underneath Leo in the maps will be found the foolish modern constellation of the Sextant. 35 Sextantis is worth looking at, as a curious disagreement exists as to the colour of the comes. There is a bright nebula, too, worth examination, in Sextans. It is 163 of Sir William Herschel's 1st Catalogue.

Hydra, straggling across the sky beneath Cancer, Sextans, Crater, Corvus, Virgo, and Libra contains a considerable number of interesting objects, though but few of them are susceptible of easy recognition. ε Hydræ is a fine pair, but difficult with such an instrument as we are employing, on account of the proximity of its components, and of their disparity in size. Of the objects in Crater and Corvus (two figures perched by the map-makers on Hydra's back), we need here only allude to 17 Crateris, an easy double star, with prettily-contrasted colours; and to δ Corvi, wider apart still, but exhibiting even more prominent tints in its components. About three-quarters of the way upon an imaginary line drawn from α to δ Corvi will be found a nebula, 65 of Sir William Herschel's 1st Catalogue. By this time, the incipient astronomer will probably feel that he has accomplished a fairly good night's work. Our next night we shall devote to Virgo and the neighbouring region of the sky.

A SPINNING-TOP.

IN an American paper, the *Literary Microcosm*, the following questions are asked:—

1. Why does a rapidly spinning-top, when tilted, tend to assume an upright position?

2. Why does it swing bodily and slowly around its pivot?

3. Why does this bodily motion take the direction of that part of the revolving surface of the leaning top which is nearest to the ground? And

4. Why does this bodily movement of the top become faster as its rotatory movement becomes slower?

These questions are worth careful study. The *Literary Microcosm* gives an utterly unscientific answer, based on the absurd conception that force is matter, and somehow explaining at the same time the rotation of a top and the duality of man; but the questions are really of interest, especially the first. We leave them to our readers, noting that a number of interesting experiments may be made by modifying the shape of the rotating body, and the manner of its rotation. One of these we have described in No. 11, p. 219.

The Editor.

Reviews.

ELECTRICITY AND MAGNETISM.*

A DEBT of gratitude is due to writers like Professor Thompson, who, being thoroughly masters of their subject, present, not their knowledge, but what the student wants to know of the subject, in clear and simple terms. The present book is a capital specimen of the sound popular science-treatise. It is clear, compact, and correct. It does not wander off into disquisitions about a multitude of matters too profound to be of interest to the learner; but every chapter, in every section, in every sentence, goes straight to business. The theory of electricity adopted by Professor Thompson is that electricity, whatever its true nature, is one not two, and that this electricity, whatever it may prove to be, is not matter and is not *energy*, but resembles both in one respect, that it can neither be created nor destroyed. The question whether positive electrification or negative electrification be the state in which there is more electricity than in the surrounding space is not decided, but Professor Thompson inclines to the belief that negative electrification is really the state of *excess*. The fact that the rate of dissipation of charge is greater for negative than for positive electrification seems certainly to point this way, for the law of the loss of charge is precisely the counterpart of the law of loss of heat, and it is well known that for equal differences of temperature between a body and its surroundings, the rate of loss of heat is greater at a higher temperature than at a lower, *i.e.*, the body that is really hotter loses its heat fastest.

The "Lesson on Terrestrial Magnetism" is one of the most interesting in the book. The statement that the north magnetic pole is in a particular latitude and longitude, ought, perhaps, to be modified, so as to indicate the probability, or rather the certainty, that the magnetic pole changes with the magnetic meridians. But this comes out clearly enough from other statements. The book is well illustrated and carefully printed. Wherever formulas occur, they are correctly given; this, in fact, is a characteristic of all works published by Messrs. Macmillan.

SPELLING AND PUNCTUATION.†

EVERY author and intending author, many students, and all printers, may study this little treatise with advantage and interest. It is also worth reading by those before whom the work of authors and compositors is presented in the form of printed books. "Literary men," says the late Mr. Beadnell, in the preface, "seldom pay much attention to such matters as punctuation and syllabication, often little to spelling (!); trusting to the printer, or rather his readers, to correct the errors and supply the deficiencies of their manuscripts." They ought not to do so, at least as regards punctuation; for the man who has thought out a subject should know better what he means to say about it than the compositor, who has simply to set up the author's words, and incorrect or defective punctuation often plays the mischief with the ideas which an author intends to present. Unfortunately, writers who are careless in this respect, injure those who punctuate for themselves. Printers have naturally learned to believe that an author, like Artemus Ward's "literary cuss," "can't punctooate wuth a cent"; so they punctuate for him, even when he has most carefully attended to the matter. He writes, let us say, "Rocks which are covered with seaweed are to some degree protected from the sun's heat," and by putting a comma after the words rocks and seaweed, they make him lay down two general propositions—very far from his real meaning—these, namely, that rocks are, as a general rule (1), covered with seaweed, and (2), to some degree protected from the sun's heat. So that, because many writers are too lazy to punctuate properly, the careful writer has to watch lest his meaning should be perverted by incorrect or concealed by excessive punctuation. Mr. Beadnell gives a very logical account of the comma, colon, semicolon, parenthesis, dash, &c.; it may be doubted, however, whether a little common sense is not better than the laws of logic, as a guide in this matter. In one or two places it has led our author astray. Thus, he says that where the subject of an affirmation has certain words attached to it which constitute the predicate and complement of the proposition, and are not (as they at first sight look) a thought interposed between the subject and the predicate, there must be no comma after the subject, giving as an example this sentence:—

> The French demurring to the conditions which the English commander offered, again commenced the action.

Here, he says, the Frenchmen's demurring to the conditions is not mentioned incidentally, as a parenthetical explanation, but is the principal proposition of the sentence upon which the next proposition depends. And then he gives, as a somewhat different example, to render the matter clearer, this:—

> The French having occupied Portugal, a British squadron, under Rear-Admiral Sir Samuel Hood, sailed for Madeira."

But the two cases are not only different, they are diverse. In the first sentence the punctuation is clearly wrong, in the second it is clearly right. The first is really equivalent to this: "As the French demurred to the conditions which the English commander offered, again commenced the action," which is absurd; a comma after "French" puts the sentence right. On the other hand, a comma after "French" in the second sentence makes it wrong and absurd (logically, it could then only bear the interpretation that Portugal is a British squadron under Rear-Admiral Sir Samuel Hood, which the French occupied, and then sailed for Madeira). The proper way of treating the first sentence, in order to show the importance of the words "demurring to," &c, is to do what Macaulay used to do in such cases (and very often when it was not wanted), to make two distinct sentences, thus:—

> "The French demurred to the conditions," &c. "They again commenced the action."

GEOMETRICAL EXERCISES FOR BEGINNERS.*

THESE exercises are intended to assist the young student of geometry to understand those propositions with which he has later to become familiar. They will be liked by lovers of old Euclid, as they deal more with ancient than modern geometry, and adopt the ancient methods of presenting geometrical truths. In some respects we are glad to see this, in others the ancient methods are not so well. We believe few things in Euclid, for instance, serve more to repel beginners than the general form in which the enunciations are presented. Not only—which is something—is a good deal of space wasted, but—which is

* "Elementary Lessons in Electricity and Magnetism." By Sylvanus P. Thompson, Professor of Experimental Physics in University College, Bristol. (London: Macmillan & Co.)

† "Spelling and Punctuation:" A Manual for Authors, Students, and Printers. By Henry Beadnell. (Wyman & Sons, London.)

* "Geometrical Exercises for Beginners." By Samuel Constable, Trinity College, Dublin.

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much more—the beginner has his attention first directed to a general proposition, which is often far from clear. The learner is always readier to understand particulars than generals; but in Euclid he has to give much thought to the interpretation of a statement couched in terms which seem to him vague and perplexing, until he has read their interpretation in the beginning of the demonstration. Then, if he really wants to understand what he is about, he goes back to the enunciation. There is no reason why this round-about course should be followed. Instead of beginning, for instance: "If two triangles have two sides of the one equal to two sides of the other, each to each, and if the angle contained by the two sides of the one be equal to the angle contained by the two sides, equal to them, of the other," and so forth—why should not the proportion proceed thus: "If in the triangles ABC, DEF, AB is equal to DE, and BC to EF, also the angle ABC equal to the angle DEF," &c. The attempt to interpret the meaning of the enunciation as a general proposition is in reality so much waste labour. It is akin to the waste labour which children at school used to be invited to bestow on such grammatical propositions as these, Where contingency and futurity are both implied, the verb should be in the subjunctive, instead of being told that such a sentence as "If it rains" is correct when you mean "if it is raining now," and incorrect when you mean "if it should rain to-morrow." Of course, the principle of these general propositions is sound enough, if we are writing for logicians, just as it is sound enough to define a plane superficies as one "in which any two points being taken, the straight line between them lies wholly in that superficies." But definitions and enunciations of logical precision are not for beginners. We wonder what Euclid would have said if he had been told his treatise would be used for learning first lessons in geometry? It is a pity, we think, that Mr. Constable did not simplify his book a little in this direction, having no enunciation distinct from the explanation of the figure. Even for more advanced mathematicians, enunciations are emphatic nuisances; the time given to interpret the roundabout phrases, necessary when a figure is not referred to, is just so much time wasted. So is the time wasted which is given to the wording of such enunciations. Often, despite the time thus wasted, the enunciation is not intelligible till a figure is drawn illustrating it. Thus "if from two diametrically opposite points on the circumference of a circle perpendiculars be drawn to a straight line outside the circle, the sum of these perpendiculars is constant." How are we to interpret this? Constant wherever the line may be, or whatever the size of the circle? or in whatever direction the diameter is drawn? or may any two of these vary? or all three? Still, this happens seldom in the book before us, and the use of enunciations is common to a great many treatises on geometry. The propositions are clearly and simply dealt with, and the work is very carefully printed and illustrated. In proposition 18, p. 135, it should be noticed that the construction fails if triangle SPR is less than one-nth part of the quadrilateral. There are, however, very few mistakes in the book.

DR. LUYS ON THE BRAIN.*

Dr. Luys has adopted a method of cerebral research which he regards as of extreme value. He makes regularly stratified sections of the cerebral tissue, and has these faithfully reproduced by means of photography; he then employs successively-graduated magnifying powers for the representation of certain details. By these new methods he has been able, he considers, "to penetrate further into the still unexplored regions of the nervous centres, and, like a traveller returned from distant lands, to bring back correct views and faithful representations of certain territories of which our predecessors caught scarcely a glimpse." After carefully surveying the elementary properties of the nervous elements, he arrives at the conclusion that it is by means of their combination, and by the harmonious co-ordination of all their truly specific energies, that the brain feels, remembers, and reacts; and that, in fact, they are the only living forces present, always underlying the infinite series of operations which the brain every moment accomplishes; and that, in fact, without them, that admirable and complex apparatus, at once so delicate and so simple, would be as absolutely without life and without movement as the earth would be, without the sun.

The present work, in which Dr. Luys thus endeavours to carry the data of contemporary physiology into the hitherto uninvaded domain of speculative psychology, is full of interest, despite its occasional too technical terminology. The book is in part suitable only for medical men, but in greater part it is easily to be understood by the general reader. We may not accept Dr. Luys' opinion that "from this time forth a true physiology of the brain has been established as legitimately as the physiology of the heart, lungs, or muscular system," but he has done much to show that we are fairly on our way towards this result, "a consummation devoutly to be wished."

Some of the facts used by our author to illustrate his views are very interesting when thus viewed. Such, for instance, are the familiar phenomena of association. "It is sufficient," as he says, "to see an object or a person—to hear a name pronounced accidentally, to smell an odour—in order to feel arising within us a series of ideas which arose at the moment when this impression was at first perceived by us. We all know how frequently in current conversation a word—a simple sound—causes the primitive direction of our ideas to diverge." This curious property, which sensorial impressions, received at the same time, possess, and which constitutes, as it were, natural families among them, is a great resource in the education of the intellect, and the methodic cultivation of the faculties.

Among the singular facts referred to in this work may be mentioned the experiments of Charles Robin, on the corpse of a decapitated individual (Ch. Robin, "Journal de l'Anatomie, Paris 1869, p. 90). They showed that the automatic activities of the spinal cord in man may continue to exhibit undiminished energy, and power of co-ordinations in the form of regularly-associated movements with a definite object (such as movements of defence made by the hand after a cutaneous excitation), these being performed with as much regularity as though the brain had directed them.

* "The Brain and its Functions." By J. Luys, Physician to the Hospice de la Salpétrière. (London.)

GANOT'S PHYSICS.*

A book so well known and so widely valued as Ganot's Physics, scarcely requires the evidence which the issue of a tenth edition affords, to show that it is thoroughly sound and trustworthy. It is a text-book which fulfils the purpose which we have set before us in Knowledge, being clearly worded, yet exactly described. It is very well illustrated, and the various physical subjects dealt with in

* "Elementary Treatise on Physics, Experimental and Applied." For the Use of Colleges and Schools. Translated and edited from Ganot's "Éléments de Physique." By E. Atkinson, Ph.D., F.C.S. Tenth edition. (Longmans & Co., London.)

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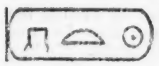
its pages—the properties of matter, hydrostatics, pneumatics, acoustics, heat, light, magnetism, and electricity—are thus rendered as clear as they can be without actual experiment. But no student of science can read these pages without wishing to make, or to witness, some, at least, among the many experiments which are here illustrated and described. The tenth edition is enlarged by nearly 25 pages, and includes 24 additional illustrations. A very valuable feature of the work is the great number of numerical problems and examples in Physics. The student should not consider that he understands any section until he is able readily to work out for himself the problems illustrating that section.



WERE THE ANCIENT EGYPTIANS ACQUAINTED WITH THE MOVEMENT OF THE EARTH?

IN the *Zeitschrift für Ægyptische Sprache* for 1864, the eminent Egyptologist, M. Chabas, published an essay to prove the Egyptians considered that the earth travelled in the heavens in a similar way to the sun and stars. The texts which showed this interesting fact are contained in two duplicate papyri at Berlin, numbered 2 and 4 of that collection, and as we believe no description of the narrative they contain has appeared in England, and it will assist students in arriving at a due appreciation of the scientific knowledge of ancient Egypt on the subject, it will be worth while to give a short account of its chief features, especially as we shall see in the sequel another text has been deciphered which corroborates M. Chabas' translation.*

The chief facts detailed in the Papyri are as follows:—The agent of a high Egyptian functionary, of the name of Meruiteus, had assaulted and robbed an agricultural labourer, who thereupon appealed to him for redress. Meruiteus referred the matter to the king; his majesty, however, considering that he could best decide the question for himself, ordered him to make a proper inquiry and adjudicate on the spot. What the result was we do not know, because the Papyri are incomplete. The necessary evidence seems to have taken a long time to collect (perhaps Meruiteus purposely postponed judgment), and during all this period the poor man was kept apart from his family, notwithstanding his continual appeals to the functionary to permit him to have access to his wife and children. Nearly all the papyri are occupied with the pleadings of the peasant and replies of Meruiteus, and they are often so lengthy, and contain so many references to those high principles of justice and humanity, the maintenance of which were always the boast of the good Egyptian, that it seems likely the mere legal account of the case had been utilised by some scribe, who, by greatly amplifying all the arguments, contrived to inculcate many precepts of morality. It certainly seems very improbable that such interminable speeches, couched in excellent language, and touching upon subjects of great theological and scientific importance could proceed from the lips of a simple peasant. As might be expected, the suppliant endeavours by fulsome praises to soften the heart of the man who was to pronounce on his case, and among some of his hyperbolical encomiums occur the words which are of so much importance to us:—"The peasant came to supplicate the seventh time, saying"—"Great governor, my lord, thou art the helm of the (entire) earth, the earth navigates—according to thy will: Thou art the second brother of Thoth."

In order to properly appreciate this sentence, it must be remembered that in the Nile valley, where the river formed the great artery of communication, the idea of travelling or movement had from the first been associated with navigation. Hence we find that as determinatives of verbs signifying a journey, the figure of a boat, or two legs walking, are used indiscriminately. M. Chabas shows conclusively that the hieroglyphs here translated to navigate are precisely similar to those employed in speaking of the journey of the sun daily through the sky, and, among many other texts cited, quotes some referring to the motion of Mars and the apparent movement of Orion. The Egyptians, it should be remembered, always alluded to the heavens as an ocean (see also Genesis, i., 7), and spoke, in their figurative way, of the stars as personages, who sailed upon this celestial sea in sacred barks.

* Maspero says that, according to a Berlin papyrus, the sun itself was considered to obey the law of universal motion, and to travel in space like the wandering stars. See "Hist. Ancienne."

The title which the poetic countryman gives Meruiteus, of helm—viz., guide of the earth—refers to the imaginary rudder which steers the course of the barque of the earth in space. The words "second brother of Thoth,"[are also noteworthy, he being a form of the deity, with two partly distinct phases. In one case he was the god of letters, and the primordial intelligence and order which established the harmony of the heavens, and made all the earth contained, and he it was who caused light to shine in the primæval gloom before the creation of the sun, and for ever guides the stars in space as Meruiteus was said to steer the earth. In the other, he was a lunar deity, and pre-eminently the brother of the earth from an astronomical point of view. In concluding this account of M. Chabas' paper, it may be mentioned that the Pharaoh to whom Meruiteus referred is named Neb-ka-ra. This King is the forty-fifth on the Sakkara tablet, replaced seventh in the third dynasty by Maspero. He is, therefore, a monarch who flourished before the erection of the Great Pyramids. From this and the very ancient character of the writing of the papyri, it is evident that the texts are of extreme antiquity. For how many centuries previous to their being penned the Egyptians knew of the movement of the earth, cannot, of course, be decided.

A MEMBER OF THE SOCIETY OF BIBLICAL ARCHÆOLOGY.

(To be continued.)

MALARIAL ORGANISMS IN THE BLOOD.

IN the blood of patients suffering from malarial poisoning M. A. Laveran has found parasitic organisms, very definite in form and most remarkable in character. Some were cylindrical, curved bodies, pointed at the extremities, with a delicate outline and a transparent body, colourless except for a blackish spot in the middle, due to pigment granules. On the concave side a fine line could often be traced, which seemed to unite the extremities of the crescent. These bodies presented no movement. Spherical organisms were also seen, transparent, of about the diameter of a red blood corpuscle, containing pigment grains, which, in a state of rest, were often arranged in a definite circle, but sometimes presented rapid movements, and then lost their regular arrangement. On the borders of the spherules very fine filaments could often be perceived in rapid movement. These filaments were in length three or four times the diameter of a red corpuscle. Their number varied. Sometimes three or four were seen round a spherule, to which they communicated an oscillatory movement, displacing the adjacent red corpuscles. The free extremities of the filaments were slightly reflexed. When at rest, the filaments were invisible on account of their tenuity and perfect transparence. These mobile filaments appeared finally by becoming detached from the pigmented spherules, continuing, however, to move freely amidst the corpuscles. There were also bodies of spherical or irregular form, transparent or finely granular, about the hundredth of a micro-millimètre in diameter, containing dark red, rounded pigment grains, either regularly arranged at the periphery, or aggregated at some part of the spherule. The bodies and granules were both motionless. These appear to be the ultimate or "cadaveric" stage of those last described. They have no nuclei, and do not tint with carmine, a distinction from the pigmented leucocytes with which they have hitherto been confounded. Lastly, spherical elements were met with similar to those already described, but much smaller in size, and apparently representing a stage in their development. The animated nature of the mobile pigmented spherule, furnished with filaments, appears indisputable. M. Laveran regards it as a form of animalcule, which exists at first in an encysted state, and in the perfect condition becomes free in the form of mobile filaments, a mode of development not uncommon among the lower organisms. Besides these organisms, the blood of patients suffering from malarial fever contains (1) red corpuscles, which appear to be vacuolated at one or two spots, and contain pigment granules; (2) pigmented leucocytes; (3) free pigment granules, possibly proceeding from the destruction of the parasitical organisms.

These elements were first discovered by M. Laveran a year ago, and since then he has examined the blood in 192 patients affected with various symptoms of malarial poisoning, intermittent and continued fever, and palustral cachexia, and found the organisms in 180. The disease had been contracted for the most part in different regions of Algeria and Tunis. He convinced himself, by numerous and repeated observations, that these organisms are not to be found in the blood of persons suffering from diseases that are not of malarial origin. In most of the cases of malaria in which the examination yielded a negative result the patient had undergone a course of treatment with quinine, and to this fact the absence of the organisms from the blood was probably due. The addition of a minute quantity of a dilute solution of sulphate

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of quinine to a drop of blood was found at once to destroy the organisms. In all the examinations great care was taken to preclude the entrance of any extraneous objects into the drop of blood examined. In general the parasitic bodies were found in the blood only at certain times: a little before, and at the moment of, the accession of the fever. In some very obstinate cases the organisms were always present in the blood. They rapidly disappeared under the influence of a quinine treatment. It is conjectured that in the apyrexial intervals the organisms probably sojourn in internal organs, especially the spleen and the liver. After death from malarial disease, pigment granules are found in great numbers in the blood, and especially in the small vessels of the spleen and liver; and they may be, in the most severe cases, so abundant that not only the spleen and liver, but the marrow of bone, and even the grey substance of the brain, are darkened by their presence. These pigment granules, which may obstruct the capillary vessels, appear to be derived from the parasitic elements, which perish after death, and become then unrecognisable.—*Lancet.*

THE "SOUND" OF FISHES.

THE letter of your esteemed contributor, Mr. W. Mattieu Williams, on the subject of fish "sounds," affords a remarkable illustration of the truth of the old saying that a cobbler should stick to his last. For, so long as he confines himself to physics, his contributions are most valuable and interesting (especially the one in the issue for Feb. 10), but passing into the domain of the biologist, he must, I fear, be regarded as an intruder. The alleged mistake on the part of Dr. Andrew Wilson and the writers of anatomical works, is, I submit, no mistake at all, for that structure which fishermen and the public in general style the "sound" of a codfish is, indeed, the swim-bladder. Of course, my mere *ipse dixit* is of no more value than that of Mr. Williams, but in this case, as in a controversy between Professor Huxley and Mr. Waterhouse respecting the Scotch hares, the animal intervenes. I happen to have been to-day engaged in the dissection of a codfish, and can thus speak from actual observation to the following facts:—Firstly, the dorsal aorta is so completely hidden by the swim-bladder as to be inaccessible to any but persons accustomed to the use of the scalpel. Secondly, that it is of such insignificant size as to be utterly worthless as an article of diet. The fish upon which I operated weighed about 8 or 9 lb., and the dorsal aorta was a delicate, thin-walled tube about one-twelfth of an inch in diameter. Thirdly, that it was not "attached by its edges to each side of the under part of the spine of the fish," but that the swim-bladder, which is a "stout membranous bag," was so attached. The suggestion as to the etymon of the word "sound" appears, so far as I am able to judge, a very probable one. Old Fossil.

THE PYRAMID OF MEYDOOM.

MISS AMELIA B. EDWARDS quotes, in the *Academy*, the following letter, received by her from the Hon. J. Villiers Stuart, author of "Nile Gleanings":—"The other day I visited Meydoom. The pyramid has now been cleared down to the level of the desert, to which it descends in a series of great steps of beautifully-fitted masonry of fine white limestone. The joints are so close that it is often difficult to trace them. It is, in fact, more like cabinet-maker's work than mason's work. It must have been covered up from the remotest times, as it looks quite new towards the base. You would say it was but just finished. It comes next in size to the Pyramids of Ghizeh. The central chamber is tent-shaped—that is to say, the walls incline inward toward the roof, so as to reduce the span, and better enable it (the roof) to bear the enormous superincumbent weight. There were found in this chamber some pieces of timber, which seem to have been used to remove some heavy weight, perhaps the sarcophagus. It is, however, possible that, as in the case of the Pyramids of Ghizeh, there may be another chamber in which the sarcophagus still exists.

"When I last saw Prof. Maspero he seemed to doubt whether this was really Seneferoo's pyramid; but within five minutes' walk of the pyramid I discovered an inscription which conclusively proves that it is indeed the pyramid of that Pharaoh. The inscription occurs on the right hand top corner of the tomb of Nofre-Maat. It reads Senefероо Mente—*i.e.*, the 'resting-place,' 'abiding-place,' or 'cemetery' of Seneferoo. There is no context, and never has been any. The stone is quite uninjured, and the purpose of the inscription is to designate the locality in which the tomb is situated. It might be translated 'monument,' or 'pyramid of Seneferoo,' the name of which would attach itself to the adjoining cemetery. The hieroglyphic spelling of Mente (being the sign *Men* without the supplementary *n*) is very archaic. The inscription was probably cut during Seneferoo's lifetime. The reason why I failed to observe this important and interesting inscription on previous visits is that it is very high up; but the tomb of Nofre-Maat is now nearly filled with rubbish, which enabled me to mount close up to the hieroglyphs, and to examine them thoroughly. I saw the oval before, and figured it in 'Nile Gleanings' (p. 33), but not having an opera-glass with me, I overlooked the context. I have written to Prof. Maspero to tell him about it."

"The inscription," proceeds Miss Edwards, "copied in hieroglyphs by Mr. Villiers Stuart, consists of Seneferoo's name in a royal oval, under which, placed vertically, occur the ideographic sign, *Men*, a battlemented wall, and the phonetic sign *t*, an inverted basket. But in order to complete the word as given by Birch, Brugsch, and Pierret, not merely the supplementary *n* (a zigzag) is wanting, but also the determinative hieroglyph, a funereal couch, or bier. I regret to have to add that, at the time of writing the foregoing letter, Mr. Villiers Stuart informs me that he was suffering severely from a fall down a shaft 20 ft. in depth. He has, however, escaped without serious injury."

A PRETTY GEOMETRICAL PROBLEM.

(*Page* 229, *Jan.* 13.)

EXCEPT the propounder of the question, none of our readers have correctly solved either this problem, or Mogul's ("Given any rectangle, divide it by the fewest possible straight cuts, so that the parts can be put together to form a square"). J. Horne and ATC have given solutions of Student's problem, which at a first view seemed correct and neat. But they were not in reality sound.

Student's solution is as follows:—

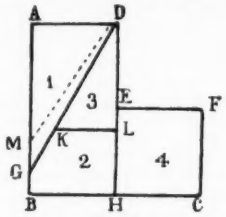


Fig. 1.

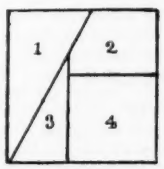


Fig. 2.

Taking AM = AE, join DM, and take AG = DM. Produce DE to H and in EH take EL = GB. Draw KL parallel to BH. Number the parts as shown in Fig. 1, and fit them together as shown in Fig. 2. It is easily shown that they fit into a perfect square.

The problem cannot be solved with fewer cuts, but there are several other ways in which it can be solved with as few cuts, and an infinite number of ways in which it can be solved with five cuts.

Mogul's problem is so excellent that, supposing readers may have overlooked it, we leave it for another fortnight as an exercise.

Editor.

INTELLIGENCE IN ANIMALS.

MANY years ago, when a boy, I was at a country market with two friends, who each had a gig, and it was arranged that they would both drive home in one gig, while I drove the other. After journeying some four miles, I had got a considerable distance in advance, and arrived at the gate of a private avenue, towards which the horse turned, and then stopped, refusing to move another foot, although I tugged at the reins, whipped him, and even got out and tried to lead him on to the high road again, for I was quite familiar with his usual route, and had driven him on previous occasions, but move he would not. When my friends came up I was told that the horse had been accustomed of late to go through this avenue, it being a short cut.

In the year 1867 I got several monkeys at Auger Point (Java), and among them were two males, which we named Smiler and Tadpole, the former so called because when anyone went near him he showed his teeth in such a way that he appeared to be smiling, the latter because he had an unusually large head, while his body was small and weakly. Whenever these monkeys were fed, Smiler always managed to dispose of his food before Tadpole had commenced upon his reserve pouches in his cheeks. Smiler would then seize Tadpole, get him on his back, strike him under the jaw

to throw the food from the pouch into the mouth, then thrust his hand into Tadpole's mouth, and take out the half-chewed food, which he at once transferred to his own.

One day, while off the Cape of Good Hope in a gale, with a heavy sea running, our ship was close hauled under the lower topsails and fore-topmast staysail, when Smiler escaped from his house and ran aloft, perching himself on the fore-topmast cross-trees. Fearing lest he might be blown overboard, I sent a man aloft to catch him. When Smiler saw the man coming after him, he slipped down the jib halliards just beyond reach. The man shook the halliards, with a view of making him slip down to the jib-boom end, where another man was stationed to catch him, but Smiler losing his hold was blown far to leeward, and for the time disappeared.

We were all anxiously looking to leeward for him, but he was nowhere to be seen, when the cook rushed to windward, and putting his head over the rail saw him abreast the fore-rigging, and within heaving distance. An iron bolt was bent to the log-line and thrown to the little fellow, who immediately seized hold and was successfully hauled on board, smiling grimly.

Again, in the year 1869 I got a retriever pup in Yokohama, which I used to drill during the dog-watches at sea, by throwing articles along the deck for him to fetch back. Among other things was a soft felt hat, with a rather tall crown. At first this hat perplexed him much, as he usually seized it by the rim, and in running along the deck with it, tripped himself up by catching his fore-paws in the crown. After repeated trials with the same result, he laid the hat dow, and with his fore-paws and mouth rolled it up, and carried it in that manner. OCEAN.

A CARNIVOROUS PARROT.

THE remarkable bird, the *Nestor notabilis*, or Mountain Kea, of New Zealand, is a parrot of strong frame and powerful bill and claws, which were used, like those of all parrots, for obtaining a vegetable diet, until the colonists introduced sheep and pigs. As soon as this was done, the Kea seems to have abandoned vegetable food, and to have taken entirely to flesh eating. He attacks sick, or dying, or disabled sheep, and, with his powerful cutting beak, opens a passage through the back, and eats the intestines. Even healthy animals are sometimes assailed by the *Nestor notabilis*, and there are sheep-runs in New Zealand where considerable losses have been incurred through these strange birds. The specimen in the Zoological Gardens gave as much trouble to capture as an eagle, tearing the clothes of the shepherd, who knocked it down while pouncing on a lamb, and lacerating his hands. The Kea scorns cooked meat, biscuits, fruit, or seeds, and likes raw mutton better than any food. He will tear the skin and flesh from a sheep's head after the furious fashion of a vulture—leaving nothing but the bare skull. He at one time holds the morsels in his lifted claw, after the style of parrots, and at another grips them under his feet while rending with his feet like a hawk. This is a curious example of change of habit, for there is every reason to believe that before sheep and pigs were introduced into New Zealand the kea was as frugiverous in its meals as most, if not all other, parrots. He will now eat pork and beef as well as mutton, and has become, in fact, utterly and hopelessly carnivorous. It is to be feared, after this example, that temptation is often fatal to birds and beasts, as well as man. Had it not been for Captain Cook and the English sheep flocks, the *Nestor notabilis* would have lived and died innocent of crime; but now its blood-stained carcase is suspended outside many a sheepfold near Otago.—From the *Daily Telegraph*.

JACKO: A BABOON'S BIOGRAPHY.

MANY years ago, when stationed at an outpost on the Great Fish River, in the eastern frontier of South Africa, I was presented by the officer I relieved with a young baboon, which, when captured, was so young that it had to be brought up by hand.

From the first, I took a great deal of notice of it, and it became very much attached to me. It made great progress and grew up a healthy, strong animal.

Jacko was mischievous beyond expression, and the first time that I discovered that he had a temper of his own was on the following occasion:—

I had given him a saucer of bread and milk, and my wife, seeing that he had emptied the saucer, stooped, and put out her hand to remove it. He immediately flew at her, and tore her collar, making a hideous noise. I said, "This will never do, Master Jacko, you must be taught manners," upon which I handed my wife her riding whip, and desired her to whip him, holding him, myself, firmly. He howled and screamed loudly, looking round the while in search of something to fly at, but never attempted to touch either myself or my wife.

Jacko was always secured by a leather strap round his loins, to which was attached a strong steel chain, the end of which was secured by a strong padlock, which clasped an iron ring. This ring traversed freely up and down a pole, some seven feet in height, on the top of which a board was nailed, which, of course, kept the iron ring safely on the pole. This board was Jacko's favourite seat and post of observation. He was perfectly aware that the padlock and the board were his detainers; for he was constantly either picking at the padlock or working at the board, to try and loosen it, and, incredible as it may seem, he actually succeeded in disengaging the iron plate from the padlocks, compelling me to renew them frequently.

Jacko's pole was always erected close to my quarters, and I could watch his proceedings from my window unknown to him, and they were always most amusing. It is the custom in barracks for the pioneers to go round and sweep up the barrack square. One morning I saw a man, with a wheelbarrow full of straw and other rubbish, sweepings of the square, put down his barrow near Jacko's pole while he was sweeping in the immediate neighbourhood. Jacko was seated upon his high perch, apparently taking no notice of what was going on. Presently I saw the pioneer disappear to sweep round a corner. Jacko was down like lightning, capsized the barrow, and with his long and powerful arms scattered the contents in every direction, and when the pioneer appeared, was up on his perch again with wonderful celerity, looking in quite a different direction, with a face of the most ludicrous innocence.

One morning, from my look-out window, seeing Jacko come down from his perch very demurely to the ground, and slacken his chain, and then lie down, as if innocently basking in the sun, I felt fully aware that mischief was brewing. Presently I saw a fat little puppy appear on the scene, and Master Jacko's sleepy-looking eye fixed upon it most intently. When the puppy had strayed within reach, Jacko's chain was quietly tightened, and with his hind leg he seized it; and immediately clasping it in his arms, he clambered with it to the top of his high perch. For a short time the puppy was nursed and dangled in his arms, just as a woman would nurse a baby; then he began a careful search for fleas, with which the poor little thing was tormented. All at once a bright idea seemed to strike him, for, grasping the puppy by the tail, and holding it out at arm's length, and, looking, with an expression of most innocent demureness, in the opposite direction, he quietly opened his hand, and down fell the poor little animal, with a "thud," to the ground. I ran out to succour the poor little brute, and scolded Jacko vigorously for his cruelty, which, however, was perfectly useless, for he instantly assumed a pre-occupied air, and was apparently intensely interested in some imaginary object in the distance.

One morning I perceived that Jacko had loosened his perch, and witnessed his triumphant look when he had succeeded in throwing it to the ground. He now had nothing but the small top of his pole to stand on, and thus standing, he pulled up the chain, and brought the ring close to the top, but found his feet in the way. This puzzled him for some little time. At last a happy thought struck him, and seizing the ring with both hands, he jumped into the air, and the next minute was scouring the barrack square.

The rattle of Jacko's chain, and the cry of "Jacko's loose," was always the forerunner of a race for refuge and a slamming of doors among the female members of our community.

It was perfectly useless to provide him with any place of refuge or shelter, as his energies were at once at work to destroy it, in which he succeeded uncommonly well; so, at night, a sack was suspended from the top of his pole, into which he nestled himself with great comfort; and it is a singular fact, that at night I could go up to his pole and touch his sack, and he never attempted to move, but would give me an affectionate grunt of glad welcome, but if any other individual approached within a yard of his pole, Jacko was out of his nest in an instant, screaming, and prepared for battle.

On a cold, wet, rainy night I used often to take him a bowl full of hot coffee, and knowing there was sugar at the bottom of the bowl, he could not resist the temptation of plunging his hand into it to search for the sugar, although the coffee was so hot that he was obliged to cry out with the pain.

Had I not witnessed what I am about to relate, I could not have believed it. I have stood within thirty yards of his pole with my bow and arrow, and taking deliberate aim, have launched an arrow at him. Jacko would invariably catch the arrow in his hand, holding it until I went up and claimed it, when he always gave it up readily. But it is most remarkable that if any other person took the bow and fired at him, Jacko, on catching the arrow, always broke it in pieces. I need not say that on these occasions I invariably gave my worst arrows to my friends.

XUM

One wet afternoon I had chained Jacko up in the Cape Corps stable for shelter, and when the men had finished grooming their horses, I heard an unusual hubbub in that direction, and on going down to ascertain the cause, I found that Master Jacko had monopolised a jacket belonging to one of the men, and had covered himself snugly with it, positively refusing to give it up, and nobody dared to take it from him until I came to return it to its owner.

Jacko's pole was, of course, the centre of attraction to all the soldiers. They were always feeding him, or playing him tricks, which last he repaid with a will.

He would catch anything that was thrown at him, thoroughly investigating the nature of the article he had caught. He was very partial to eggs, whether boiled or raw, and it was most amusing to see him tossing a hot egg from hand to hand, screaming the while, but never letting it go.

He was fond of his grog, weak wine and water, which was given to him occasionally in a bottle, tightly corked, and it was one of the pet amusements to see him pick out the cork, bit by bit, with his very strong nail; but to show how perfectly well he understood the use of the cork, when he had picked away as much as he could reach with his fingers, and still found himself unable to get at the contents, he would take up the bottle and crack the neck off against his pole.

To give one instance of Jacko's deep cunning, my company was on the line of march to an outpost. My wife and I were riding a few hundred yards in rear of the men, Jacko, as usual, loose and following us like a dog. We observed a Fingoe sitting on an ant-heap, about thirty yards from the roadside, with his wife standing within a few feet of him, holding in her hand a fine cob of Indian corn. All at once we saw Jacko walk up to the Fingoe and make friends with him (a most unusual thing, as he never took to the natives), and even sitting on the Fingoe's knee. Then we saw him make a spring, and, in the jump seize the Indian corn, and, running for his life, he caught hold of my stirrup and was on the pommel of my saddle like lightning. The Fingoe was much enraged, and threw his "knob-kerie" at him, so I pacified the man, much to his delight, by giving him a bit of tobacco.

I have already said that the soldiers were very fond of Jacko, and, in the evening especially, they would surround his pole, playing with him; but if he suddenly caught sight of me coming into the barrack square, he would immediately go round the circle, biting every one of the men, dash up on his perch, and scream frantically, as if trying to persuade me that he was the injured party appealing to my protection.

Although brought up by hand, his intuitive perception of danger and recognition of his enemies were remarkable. If I wished to keep him up on his pole, I had only to coil a dead snake at the bottom of it, and no dainty would induce him to come down; and when I was absent from my post, and the alarm cry of "Jacko is loose" sounded, my wife had only to put a leopard's skin, with the head stuffed, in the doorway, and the quarters were perfectly safe from Master Jacko's intrusion.

On my being ordered home from the Cape, I left poor Jacko in charge of the men of my company, who said: "Never fear, your honour, we'll take the best of care of Jacko; he'll be our captain now." But soon after I left for England, the Kaffir War broke out, and in the confusion of war preparations Jacko's further fate was buried in oblivion. Lieut.-Colonel T. Percival Touzel.

CHANGES ON THE SURFACE OF JUPITER.

By Prof. C. W. Pritchett, Glasgow, Mo., U.S.A.

THE changes which have taken place, within the last three years, on the apparent surface of the planet Jupiter, are really wonderful. To one who has seen the giant planet but a few times in his life, and even to an astronomer, who has not noted from week to week the markings on his surface, a detailed account of their changes would be almost incredible. Perhaps the phenomenon of the great red spot, which became so conspicuous in July, 1878, and which still persistently holds its place, has awakened an unusual interest in the study of his surface; but certain it is, that never before has his disc been so closely watched, and never have so many phenomena been noted in so short a time as within the last three and a-half years.

In this note, my object is not to describe these changes, but specially to mention an instance observed here on the night of December 23. It chanced to be one of the finest nights of the whole year. The surface of the great planet was rarely ever seen under better conditions of altitude and atmosphere. Every line and marking came out with a distinctness which was a wonder even to an experienced observer. The great red spot, by the Jovian rotation, was approaching the central meridian of the disc; and I had begun my usual observation of the transit of the preceding end, when my attention was called to a condensed white nucleus situated in the north margin of the most southern of the equatorial belts. The threads of the Filar Micrometer, had been adjusted to the rotation axis of the planet, by the ephemeris of Mr. A. Marth. (Month. Not. R.A.S., vol. 41, No. 7.) One fixed thread was placed on one extremity of major axis of spot, and the movable thread was placed on the other extremity of that axis, and these threads were kept to this position by the driving clock and an adjusting screw. At 7 h. 7 m. of local mean time, the following end of red spot and the bright nucleus were on the same thread, or the bright spot was on the same Jovian meridian directly north of the following end of red spot. As it requires more than one hour for the Jovian rotation to carry the major axis of spot across the central meridian, and all changes of relative position must take place between my micrometer threads, I had a very rare opportunity to compare changes, however slight. Not twenty minutes had passed till I could see, independently of the threads, that the white spot had a rapid motion relatively to the red spot. It was so marked and proceeded so uniformly with the time that I resolved to measure it minutely. My observation of the transit closed at 8 h. 10 m. and then I estimated by the eye that the bright nucleus had gained on the following end of the red spot, in one hour, three-eights of the interval between my threads. The mean of a number of careful measures proved it to be three hundred and sixty-one one-thousandths of the interval, or 4·33″ of the Jovian disc.

Now, the question comes up, was this a motion of translation? If so, we shall have to believe that a motion can take place in the Jovian atmosphere at the rate of nearly seven thousand miles per hour. As this seems scarcely credible, I prefer to think that this angular displacement is the index of a progressing transmission of light through a lower stratum of atmosphere, or else a part of an auroral display. I am the more inclined to consider the phenomenon as the result of a progressive transmission of light from the body of the planet through changing media, since the size and consistency of the nucleus changed considerably during the hour. I decline, however, to speculate on the subject, and give the fact and measure for what they may be worth.

Within the last few years many of these bright spots have been observed. That they seem to have a rapid motion has been shown over and over again. Some of them have been followed entirely around the planet.

I will add, that for the last two years the colour of the equatorial belts has remained grey or brown; for some time previously they had borne a ruddy hue. Occasionally the margins of the main belts have been tinged with red, and sometimes with a very fine blue. Within the last two years two very marked changes have occurred: 1. There are now three distinct broad equatorial belts in place of two. 2. A very conspicuous belt now stretches entirely across the Southern Hemisphere of the planet, and in apparent contact with the red spot. Its northern margin, on the finest nights, is almost blue. It has been forming for months past, but has taken its distinct outline within the last six months. It is now a prominent feature of the great disc immediately south of red spot. It would be highly instructive could all these successive changes be presented to the eye by such drawings as would show not only the correct shape and outline through successive weeks, but also the changes in consistency, continuity, and colour.

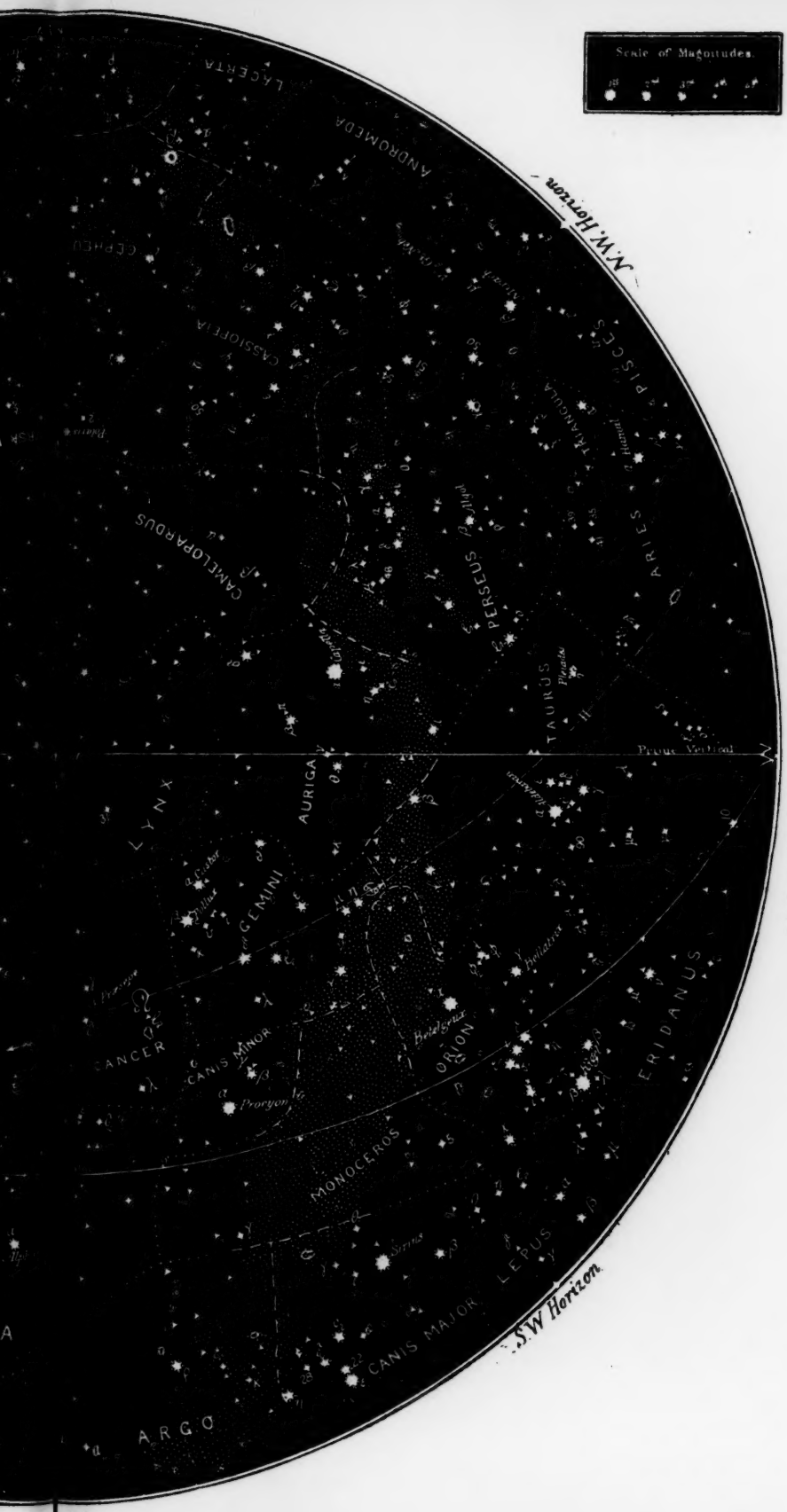
Note.—On January 22nd, at 7¼h. 30 m., an entirely new belt was observed in the Equatorial Zone of Jupiter, situated between the middle and southern equatorial belts. It was continuous and very fine and sharp. I have never before seen a belt in this position, though I have carefully examined the planet many hundreds of times within the last few years. The space between the broad equatorial belts is usually more or less filled with irregular cloud masses. On this occasion it was entirely free from them. The middle and northern equatorial belts were very fine and even, and assumed their usual ruddy hue, while the southern equatorial belt was nearly three times broader than the other two, and was quite dark. The atmosphere was the finest I ever had for distinct and steady images.

A Collie's Sense of Duty.—A touching story of sheep-gathering was recently told me on good authority. A shepherd lost his large flock on the Scotch mountains in a fog. After fruitless search he returned to his cottage, bidding his collie find the sheep if she could. The collie, who was near giving birth to her young, understood his orders and disappeared in the mist, not returning for many hours. At last she came home in miserable plight, driving before her the last stray sheep, and carrying in her mouth a puppy of her own! She had of necessity left the rest of her litter to perish on the hills, and in the intervals of their birth the poor beast had performed her task and driven home the sheep. Her last puppy only she had contrived to save.—Frances Power Cobbe, in the *Cornhill Magazine*.

XUM

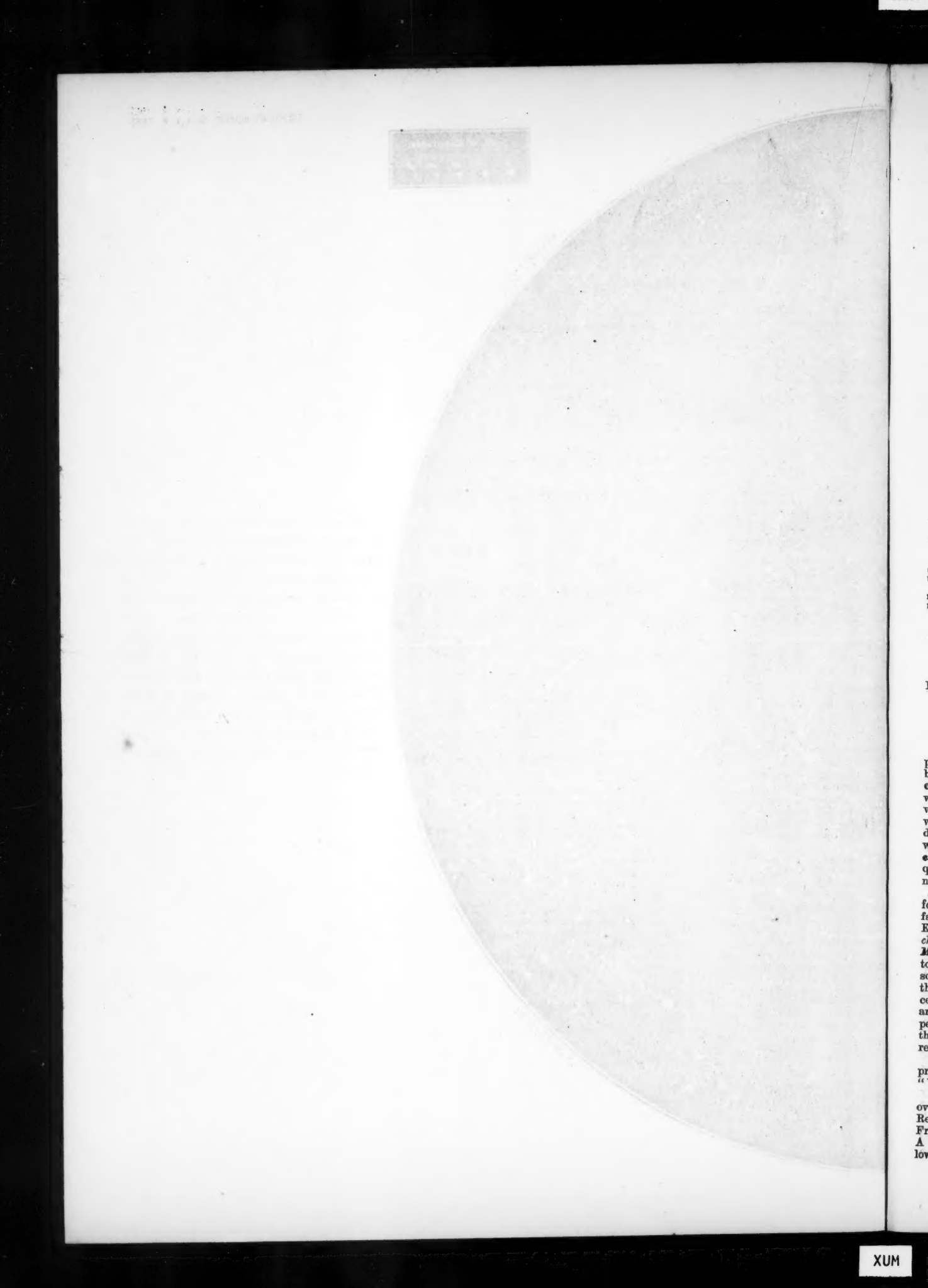
STARS FOR MARCH

On March 1, at 10.30 p.m.
On March 4, at 10.15 p.m.
On March 8, at 10 p.m.
On March 12, at 9.45 p.m.
On March 16, at 9.30 p.m.
On March 20, at 9.15 p.m.
On March 23, at 9 p.m.
On March 26, at 8·45 p.m.
On March 30, at 8.30 p.m.
On April 2, at 8.15 p.m.



Our Star Map.—The circular boundary of the map represents the horizon. The map shows also the position of the equator and of that portion of the Zodiac now most favourably situated for observation. For the motions of the planet Mars, now favourably situated for observation, see the Zodiacal map No. 11. In No. 19 (next number) the path of Uranus from January 25 to July is shown. Uranus is at his brightest on March 6, and would then be visible to the naked eye were it not that the moon, being nearly full, will obliterate him from view.

XUM



Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of KNOWLEDGE*; all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

**** All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

All Letters or Queries to the Editor which require attention in the current issue of KNOWLEDGE*, should reach the Publishing Office not later than the Saturday preceding the day of publication.*

(I.) Letters to have a chance of appearing must be concise; they must be drawn up in the form adopted for letters here, so that they may go untouched to the printers; private communications, therefore, as well as queries, or replies to queries (intended to appear as such) should be written on separate leaves.

(II.) Queries and replies should be even more concise than letters; and drawn up in the form in which they are here presented, with brackets for number in case of queries, and the proper query number (bracketed) in case of replies.

(III.) Letters, queries, and replies which (either because too long, or unsuitable, or dealing with matters which others have discussed, or for any other reason) cannot find place here, will either be briefly referred to in answers to correspondents, or acknowledged in a column reserved for the purpose.

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"There is no harm in making a mistake, but great harm in making none. Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

"God's Orthodoxy is Truth."—*Charles Kingsley.*

Our Correspondence Columns.

PRESERVING FOSSILS FROM THE LONDON CLAY.—ENCRINITES.—VENTRILOQUISM.—STRATA ON THE GREAT WESTERN RAILWAY.—DIAMETER OF THE MOON'S IMAGE IN THE FOCUS OF A 42-INCH OBJECT-GLASS.

[293]—I can sympathise with "Lepidodendron" (query 284, p. 346) inasmuch as I once had the pain of seeing a quantity of beautiful fossils of my own from the London clay effloresce and crumble to a greenish powder. The only thing to do with those who behave in such a way is to preserve them in closely stoppered vials of water as soon as they are cleared from the matrix in which they are embedded. Sheppey flints are terrible things to decompose in this fashion. The blackish metallic nodules about which your correspondent asks is iron pyrites, or sulpherised iron, called "Copperus" by the people who collected them. They do frequently exhibit traces of vegetable remains. I am ignorant of the neighbourhood of West Drayton.

"Wilfred" (query 251, p. 346) of course knows that various forms of encrinite abound in our British mountain limestone. So far as I know though, the *Encrinus liliiformis* is not found in our English rocks at all, but is confined to the German *Triassic Muschelkalk*. Its sole surviving representative is the *Pentacrinus Caput-Medusæ* in the Carribean Sea. This has a long-jointed stem fixed to the rock and supporting a cup-like receptacle containing the soft body and viscera. In the plates covering the upper part of this is an opening for the mouth. From the edge of the cup proceed fine jointed arms which ramify and ultimately terminate in articulated cirri or feelers. The joints composing the columns are pentangular, and groups of fine articulated tentacula issue from the column at intervals between the root and the top of it. It is really an echinoderm mounted on the top of a stem.

"Erin" (query 259, p. 364) will find all that is communicable in print on the subject on which he inquires in a little book called "Ventriloquism made Easy," published by Warne & Co.

In reply to query 264 (p. 364), the Great Western Railway runs over the London clay between Paddington and Reading. From Reading to Wallingford the subsoil is all chalk and chalk marl. From Wallington to Didcot we pass over the upper greensand. A few miles to the west of Steventon Station we get on to the lower greensand. After passing Uffington, we pass through the upper oolite, and at Shrivenham get into the middle oolite. From Swindon to Wootton Bassett we are again on the upper oolite; from Wootton Bassett to Chippenham in the middle oolite; and from Chippenham to Corsham on the lower oolite. Thence to Bath is through the lias stratification, which continues to Bristol. The triassic strata are next met with between Bristol and Yatton, whence a run over alluvium brings us to the mountain limestone. After this, the country is covered with alluvium, until we get to Bridgewater, between which town and Taunton our journey is mainly over the triassic deposits again. Finally, from Taunton to Exeter we practically traverse the new red sandstone for the entire distance. "Carus" should look up the account of these various formations in any elementary work on Geology.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

GREAT COMET OF 1861.

[294]—I ought to have asked admission before, but perhaps it may not be too late now, for an observation of mine on the tail of the Great Comet of 1861. I was fortunate enough to see it on the night of June 31, when its magnificence was at its height, and I obtained a very interesting sketch, with a 5½ inch object-glass, of the unsymmetrical structure of the head, which seems so frequently to characterise the larger comets. But what I wish particularly to mention was the appearance of the tail, which, as represented in the graphic sketch in KNOWLEDGE, No. 5, p. 87, was spread out like a fan. The eastern edge of this, owing perhaps to trees or a rising moon, escaped my notice; but the central ray I traced for at least 90°., first curved to the left, and then straightened near Polaris. About midnight my wife pointed out to me a great separate beam, some 3° or 3½° broad, lying far W. under the square of Ursa Major, having ψ Ursæ in the lower edge, and Cor Caroli about 1° above its upper, traceable about half-way from the latter star to Arcturus, and pointing with its other extremity to the head of the comet, though, owing to the summer twilight, no connection could be made out. In about 20m. I found that it had risen higher, so as to stand midway between ψ and γ Ursæ, and its termination, now much more distinct, was plainly visible near ε Boötis; but some times afterwards the beam was no longer visible. This unexpected change of position, contrary to the general motion of the comet, led me at the time to think that, notwithstanding its similarity to the rest of the train, it might be only a cirrus cloud lighted by the risen moon, and coming up with the breeze; but subsequent comparison with a drawing kindly sent me by George Williams, Esq., of Liverpool—much resembling the sketch in KNOWLEDGE—led me to the conviction that it was part of the outspread tail, and that the observed movement was the effect of perspective, this long streamer having passed so swiftly and closely over the earth, that the apparent closing up of the great fan from increasing distance had been distinctly perceptible.

T. W. WEBB.

IS SPACE BOUNDLESS?

[295]—In Clifford's Essays and Helmholtz's Lectures (Second series) are considerations on flat, spherical, and pseudo-spherical surfaces, which seem to destroy the certainty of Euclid's postulates and Kant's intuitions. Clifford is fragmentary, but his conclusion is evident; he prefers to believe that space is limited and spherical.

Helmholtz's lecture is obscure, perhaps owing to the translation. I know his first series suffered grievously in translation, but I can gather that the idea of limited space involves the idea of bodies and movements diminishing as they near the circumference of such space. Now, *could* Clifford entertain a belief involving such a condition? Helmholtz seems to hold that pseudo-spherical surfaces may be infinite, and may be imagined so. I cannot imagine them so, and it seems to me that a surface consisting of two opposite curves must come to an end by the curves re-entering themselves, just as a spherical surface does.

Could you do anything to make an ordinary intellect grasp these new and revolutionary views? Considering the transcendent importance of the subject, and that Gauss and Lobachewski are not to be attempted lightly, might you not give us a paper?

A word of congratulation on your journal. Its weekly appearance is quite an event here; it more than fulfils the high expectations which those who were familiar with your writings entertained on hearing of its being projected.

J. S. T.

PURPLE OF THE ANCIENTS.

[296]—May I ask, in reference to your article on "The Purple of the Ancients," what *colour* this ancient purple was? I once attended a lecture in which the lecturer proved, to his own satisfaction at least, that the ancient purple was *red*—a sort of vermilion

XUM

Your article, although telling us a lot about the dye, does not state the actual colour. Was not the Imperial purple of the Cæsars red? I have seen it so depicted in many paintings. A. J. MARTIN.

TOBACCO AND SCIENCE.

[297]—J. P. Grall [199] makes some inquiry under this head. I will make some others. When smoking a cigarette (with a mouthpiece), if, after inhaling the smoke, you remove the cigarette, holding it horizontally, you will see that a little smoke escapes from the mouthpiece and ascends; the smoke which remains in the mouthpiece does not ascend, but falls to the lower part and there remains. Why?

When smoking, no matter whether pipe, cigar, or cigarette, after inhaling puff it out immediately, and the smoke which comes out of the mouth, as well as that which gently rises from the pipe or the lighted end of cigar or cigarette is of a delicate pale blue; but if, after inhaling, you retain the smoke in your mouth for two or three seconds before exhaling it, it will be of a pale dirty-brown colour. Why should it be so? A. T. C.

THE RADIOMETER.

[298]—On exposing a radiometer to direct rays of coloured light, obtained by a sciopticon lantern and coloured gelatine sheets, I got the following results; the vanes of the radiometer in each case starting from a state of rest.

Red light: gave 39 revolutions in 1 minute.
Green „ : „ 36 „ „ „
Blue „ : „ 33 „ „ „

On turning up the light a little—

Red light: gave 46 revolutions in 1 minute.
Green „ : „ 43 „ „ „
Blue „ : „ 40 „ „ „

On turning down the light—

Red light: gave 43 revolutions of the vanes in 1 minute.
Green „ : „ 40 „ „ „ „ „
Blue „ : „ 37 „ „ „ „ „

These proportions appear constant, and would they not show that the red rays in the spectrum of solar light have most energy, and blue and violet the least? When I tried yellow light, produced in the same way, I got nearly as many revolutions of the vanes as with white light; I suppose this was owing to the yellow sheet allowing other rays to pass through. Can you advise any book on the subject? J. S. GLADSTONE.

STOVE-WARMED HOUSES.

[299]—I have read in your issue of the 3rd instant an article on the heat from American stoves. Now, sir, I trust that you will permit me to give my very long experience of these invaluable house-warmers. I lived in Canada and the United States from 1832 to 1878, in houses wholly heated by stoves. In 1854 a coal stove was brought out in Troy, State of New York, to burn anthracite coal. I procured one of these stoves and placed it in the entrance-hall of my house. That house was 64 by 38 feet, and this stove, although far inferior to the "Crown Jewel" stoves, manufactured by the Detroit Stove Company, now on view at Kensington, heated every part of my large house, which was situated on the bank of the St. Lawrence, on a bay nine miles wide, where the outside temperature was frequently 38° below zero. We kept a tin evaporator on the stove to throw off sufficient moisture, and, during the whole time this stove was in use, we never had one case of sickness. I never had one day's illness in America, and I may say that since my return to England I have been half the time sick; this I attribute entirely to the absurd way in which the English attempt to heat their houses. With the best coal fire, in an ordinary room, we are roasted on the side next the fire and cold on the opposite. Every passage and room we enter has a different temperature. We need not, therefore, be astonished at the enormous number of bronchial, lung, and rheumatic diseases so prevalent in England.

JUSTICE.

[300]—May I ask Mr. W. Mattieu Williams one question through the medium of your paper? It is not for the sake of controversy, but to satisfy my own mind on the matter of "Stove Heating." Supposing the atmosphere inside a stove-heated room to be 50° (using Mr. Williams' figures), the amount of vapour required to saturate air of this heat is sufficient to support a column of 0·361 inches of mercury, and this is easily supplied, "for an English house is enveloped in a foggy atmosphere, and encased in damp surroundings." In the open air the temperature is 32; therefore, if the fire were allowed to go out, would it not follow that because the quantity of vapour in the room would be double the amount of that in the open air, condensation of the excess of vapour would take place?—Yours, &c., G. G. D.

FOSSILS IN METEORS.

[301]—Referring to the articles "Meteoric Organisms," and "No Organic Matter in Meteors," in No. 12 of KNOWLEDGE, I beg leave to point out, in order to prevent erroneous notions about German men of science to arise among English students, especially among the readers of your truly excellent journal, that the startling discoveries of Dr. Hahn, and the extravagant theories based thereon, were, immediately after their first appearance before the public, very ably discussed and thoroughly refuted by the eminent geologist, Professor Zittel, of Munich, in a paper which appeared, if I am not mistaken, a twelvemonth ago in the *Augsburger Allgemeine Zeitung*. Dr. Hahn is, I am given to understand, not at all a geologist, but a medical man; I may be further permitted to state that he is neither half insane nor a fool, but an eager amateur, whom it would be more charitable and just to describe as possessed by a rather ludicrous illusion concerning the real value of the strange results his cherished "scientific" observations have led him to.—Yours, &c., GERMAN FRIEND OF KNOWLEDGE.

MANUFACTURE OF GAS FROM WOOD—ARRANGED SQUARES.

[302].—To make it intelligible how wood-gas (p. 246) can take the place of coal-gas for illuminating, F. C. S. should have added: for every 1,000 feet of commercial gas, 4½ gallons of naphtha are used. This being rich in carbon makes a bright, of an otherwise dull light.

The numbers in the Villa Alboni inscription, I take the Latin to say, add up horizontally, vertically, and diagonally (the maximum number of ways) to 369. This is found to be the case, and the total to be 3,321.—Yours, &c. C. T. B.

6, Prince's-terrace, Brighton.

EYESIGHT OF DOGS.

[303]—In an article on "Intelligence in Animals," in KNOWLEDGE, No. 2, page 29, there is the following remark, which I am surprised no one has already commented on, in alluding to dogs being near-sighted:—This writer says "We believe that there could not be quoted a single instance tending to show that a dog has been able to see as well as a very near-sighted man." My experiences with dogs leads me to quite a different conclusion. I had a retriever bitch which certainly saw better than a near-sighted man. To give one instance. Out shooting one day I hit a partridge very hard, which flew over a gate across a field, and fell into a cover some 200 yards off; the retriever, with its fore paws on the top of the gate, watched the bird. As soon as it fell she jumped over the gate, and ran straight to where the bird had fallen, and in a few minutes returned with it. Surely she was not near-sighted? I have often seen dogs notice game some distance off when they could have neither smelt nor heard them. A gentleman much interested in coursing tells me that he believes that many, if not most, dogs see remarkably well. Of course, dogs like Skye terriers, whose eyes are much covered with hair, cannot see so well as those which have shorter hair. One reason which may make dogs at times appear near-sighted is, that their eyes are so near the the ground that long grass, or any other obstacle, will prevent them from seeing an object which to a person of ordinary height is distinctly visible.—Yours, &c., G. S. S.

COMPARISON OF THE SEXES.

[304]—According to Huxley, the blood of men contains a larger proportion of "solid constituents" (these include the "corpuscles") than that of women; although, he adds (instructively), "the difference of sex is hardly at all exhibited by persons of flabby, or what is called lymphatic, constitution." (Physiology, Lesson iii., Sec. 17.) According to McKendrick, whereas the diameter of a single muscle-fibre is $\frac{1}{350}$th of an inch in an adult male, in an adult female it is only $\frac{1}{450}$th of an inch ("Outlines of Physiology," p. 79). The same author, on p. 82, remarks that smallness in the size of fibres, and fineness in the distribution of capillaries, and greatness of contractility, are concomitant circumstances. Thurman, a writer quoted in Bastian's "The Brain as an Organ of Mind," says, "My own observations fully confirm those of preceding writers as to the average weight of the adult male brain being about 10 per cent. greater than that of the female, *i.e.*, about 49 oz. to 44 oz." The same writer adds (see Bastian, p. 356), "For this purpose I have examined and compared the average brain weight for men and women at the

decennial periods from twenty to sixty. . . . Whilst the brain-weight is nearly 10 per cent. less in the female than in the male, the stature is only 8 per cent. less;" [and, therefore, the weight about 23 per cent. less.—ED.]—E. D. G.

CATS AND DOGS.—SCIENCE AND RELIGION.

[305]—A kitten, just weaned, was presented, a few years ago, to a near relative of mine, who already had in his house a little Maltese terrier bitch which had never had any puppies, and was not in the way to have any. Well, imagine our surprise when this little bitch at once began to suckle the kitten, and continued to do so, to my knowledge, for weeks, showing all the time an affection amounting to jealousy for the kitten. The suckling repeatedly went on upon my own lap, so in this case I will venture to state the fact positively.

May I support your own admirable resolves and dicta on this subject by the following excerpt from the "Life of C. Kingsley," near the end of vol. ii.:—"When a friend remarked that Darwin's explanation of certain geological phenomena would hardly be considered 'orthodox,' Charles Kingsley observed:—'My friend, God's orthodoxy is Truth; if Darwin speaks the truth, he is orthodox.'" E. D. G.

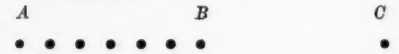
PARTIAL LOSS OF SPEECH.

[306]—Reading your article in No. 14 of KNOWLEDGE on "Brain Troubles," has brought to my mind a very interesting instance of the *total* loss of speech under mental excitement, mentioned by Darwin in his "Expression of the Emotions," &c., (chap. xiii., p. 324):—"A small dinner-party was given in honour of an extremely shy man, who, when he rose to return thanks, rehearsed the speech, which he had evidently learnt by heart, in absolute silence, and did not utter a single word, but he acted as if he were speaking with much emphasis. His friends, perceiving how the case stood, loudly applauded the imaginary bursts of eloquence whenever his gestures indicated a pause, and the man never discovered that he had remained the whole time completely silent. On the contrary, he afterwards remarked to my friend, with much satisfaction, that he thought he had succeeded uncommonly well."

ARTHUR REEVE.

OPTICAL ILLUSIONS.

[307]—The following is an illusion which, I think, has not yet appeared in KNOWLEDGE:



The distance from *A* to *B* appears to be greater than that from *B* to *C*, although they are in reality both exactly equal.—Yours, &c.,

F. W. G.

[308]—Take a sheet of penny stamps (one stamp will show it, but not so plainly as many), and look at the ellipse enclosing the Queen's head, on which are written the words "Postage and Inland Revenue." This ellipse appears of the form of a slightly elongated octagon. I see it plainer by averted vision.—Yours, &c.,

R. A. LAW.

DURATION OF LIFE.

[309]—How does Mr. Allison mean that it "depends on ourselves, in a great measure, whether we die at 35 or 75 years," when speaking of such fatal diseases as cancer, in his article under the above heading in KNOWLEDGE, page 228? S.

OPIUM—BACILLI—MICROSCOPICAL.

[310]—If "Young Pill-Box" will study the peristaltic action of the intestines in some standard physiological text-book, he will easily find the explanation he seeks. In lead-poisoning, one of the prominent symptoms is colic, *i.e.*, spasmodic contraction of different parts of the digestive canal. Opium (and, better still, belladonna), by removing contraction, relieves the constipation. Opium is also of great service in constipation from obstruction for a similar reason.

Would any of your readers kindly inform me where to find the most recent information anent Bacilli and their kindred? I mean from a natural history point of view. Most of the Botanical text-books pass very lightly over this group. I wish to study the subject from every point of view. As your readers are well aware, these micro-organisms are of the very highest interest just now (*vide* Pasteur's researches, &c.) I have Cohn's papers.

Also, will some practical microscopist kindly inform me whether the F objective of Zeiss (=1-14 in. nearly), is sufficiently powerful with a low eye-piece for the investigation (of Bacilli, &c.)? The stage appliances I possess are of the simplest, and will not permit me to use a higher power.

I, and I feel sure, many others, would rejoice very heartily if the Editor of KNOWLEDGE would arrange for the appearance of microscopical papers similar to those on the practical use of the telescope now appearing. There does not happen to be any journal which gives poor beginners in microscope technology the aid which Mr. Proctor affords to beginners in telescope work. Will he listen to the cry of A MEDICAL WELL-WISHER?

[Our correspondent will find microscopy was introduced last week.—ED.]

TELESCOPE.

[311]—I should certainly advise "Country Solicitor" (237, p. 275) to invest his money in a silvered glass reflector. He can get one by the first maker in England, of 8½ inches aperture and 6½ feet focus (the largest size he could conveniently move about), well and firmly mounted, with a battery of nine or ten eyepieces, for £40. A refractor of equal power, *i.e.* about 7½-inch aperture, would be some 10 feet long, would be almost necessarily a fixture, necessitating the erection of an observatory to put it in, and the object-glass alone, without tube, stand, or any accessories, would cost him at least twice as much as the reflector. The latter would certainly be the handier instrument of the two. He would be able to take it out of the house, and set it up in five minutes; and the silver film would certainly last, if decent care were taken of the mirror, at least two years, and, if tarnished then, would be renewed by the maker for half-a-guinea. Either the reflector or refractor would exhibit to him most of the objects in the new edition of Mr. Webb's book; though, of course, he could not expect to see the inner satellites of Uranus, or separate the close pairs in such stars as δ Equulei or ζ Sagittæ with such an instrument. H. SADLER.

VEGETARIANISM.

[312]—From letter 207, p. 251, it would appear that there are fanatics to be found amongst the opponents of vegetarianism.

The case quoted of the prisoners at Waltenburg proves simply nothing. The "theoretically nutritious" food was adopted only on the failure of the potato crop, and was certainly a poor bill of fare, even for a vegetarian. The more generous course which followed, and which created such a marked improvement in the condition of the prisoners, consisted of five articles of diet. Of these, three, at the least, enter largely into the *menu* of those who advocate the vegetarian system, and would probably have effected the same beneficial results without the aid of either meat or coffee.

ONE OPEN TO CONVICTION.

CHINESE COUNTING.

[313]—The Chinese have a method of reckoning by the aid of the fingers, including addition, subtraction, multiplication, and division, from 1 up to 100,000. Every finger on the left hand represents nine figures—viz., the little finger units, the ring finger tens, the middle finger hundreds, the forefinger thousands, the thumb tens of thousands. When the three joints of each finger are touched from the palm towards the tip, they count 1, 2, and 3 of each of the denominations aforesaid; 4, 5, and 6 are counted on the back of the finger-joints. In the same way, 7, 8, and 9 are counted on the right side of the joints from the palm to the tip. The forefinger of the right hand is used as a pointer.—Yours, &c.,

PECCAVI.

Queries.

[269]—RUST.—Why does salt water rust iron more than fresh wate.—G. W. J.

[270]—BLOWPIPE CHEMISTRY.—Could any reader of KNOWLEDGE give me the undermentioned information with reference to the blowpipe described in Vol. I., No. 7, page 137 of KNOWLEDGE, viz.: How and where the piece of brass is soldered on? also where the brass nozzle is to go; also the air balloon and the trumpet mouthpiece; and for what purpose the hole is bored through tube between A and B of drawing? as I have tried to form one and failed.—AMATEUR.

XUM

[271]—The Electrophote.—Some two years ago, an invention called the electrophote was announced, the name indicating, of course, that rays of light could be transmitted along the electric wire, reproducing at one end of it the image of objects visible at the other. Could you, or some contributor, give your readers some information regarding this wonderful but obscure invention, or state where such could be found?—Boreas. [There may have been some instrument by which a light-record of some sort was communicated; but nothing such as "Boreas" describes could have been accomplished in this way. The selenium electrophote story is probably referred to.—Ed.]

[272]—The Measures of Time and Temperature.—Will you kindly inform me how we know that two portions of time are equal, and how we know that the difference of temperature of, for instance, 60°C and 70°C is the same as the difference of 70°C and 80°C?—Frank Miller. [We may measure time by any movements we have reason to consider uniform. As to heat measures, our degrees are arbitrary, and we know, as a matter of fact, that the expansion of mercury is not absolutely uniform for uniform increase of temperature, though very nearly so between certain limits.—Ed.]

[273]—Strength of Materials.—On page 217 of Anderson's "Strength of Materials" (Longman's "Text Books of Science") the equilibrium of a 30-ton crane is under consideration, and it appears that the balance of the vertical downward pressure upon the guide-rail (108 tons) and the vertical upward pressure upon the centre pillar (72) exceeds the total load upon the structure (30 tons). Is this according to mechanical principles? and if not, where is the fallacy in the reasoning which leads up to it?—Libra.

[274]—Miscellaneous.—Will any reader briefly inform me (1) how to sort out the foraminifera of chalk for the microscope? (2) where to find a *résumé* of hypotheses on the ventricles of the brain? (3) how to get, quickly and cheaply, some notions of drawing?—Eozoon.

[275]—Salt.—On what grounds do many people object to the use of salt with food? Is this objection shared by any of our high medical authorities?—Speculum.

[276]—Photographic.—Would "A. Brothers" or any one else kindly give me their opinion on the following? 1. How to prepare iodized collodion, giving the proportions. If this would be too troublesome, as I have heard it is, where and at what price could I buy it? 2. Where can I buy the metal plates so much used by travelling photographers, how are they prepared in the conditions they are sold, what further is necessary for taking portraits by them, and what price are they? 3. How are those papers prepared sold with an imitation camera, and a small quantity of some white crystals to be dissolved in warm water, when the papers are dipped in the solution, hideous faces, &c., are developed; and what are the crystals?—W. E. F.

[277]—Luminous Paint.—Of what is it composed?—W. E. F.

[278]—Smell from Burning Gas.—What is the precise cause of smell noticed in room where gas has been burning for a time? It is noticed chiefly where a globe is used on the bracket. Is it bad consumption, to be remedied by better burner or more air, or is it caused by burning of particles of dust accumulating on the globe?—Alpha.

[279]—Stamina.—Would Mr. Grant Allen kindly explain the origin and use of the circle of pale green *cups* which surround the stamens of the Christmas rose?—Tyro.

[280]—Actinium.—Can any reader tell me where I can get zinc white pigment which turns black when exposed to sunlight, as I have not seen any sample of zinc white turn black, when exposed to light as mentioned by Dr. T. L. Phipson, F.C.S., in *Chemical News*, some months ago?—Erin.

[281]—Reflecting Telescope.—Which would be best, a metal or a glass mirror, and what metal would be best, as I am thinking of making a reflecting telescope?—T. Jones.

[282]—Is the use of smelling salts beneficial or otherwise? Why is it they are freely used by women, but not by men?—F. M.

[283]—Glass.—At what temperatures do *crown* and *flint* glasses such as are used for telescopes come to the state of fusion necessary for purification from striæ and bubbles? What materials are best suited for crucibles and moulds, resisting the high temperature of the molten glass and unattacked thereby?—Q. L.

[284]—Pencil-Point Protectors.—Will any reader kindly inform me how to restore the silver appearance to small articles made of the same material as pencil-point protectors?—Economist.

[285]—Scientific Terms.—Wanted, the name and the publisher's name of the best dictionary of scientific terms?—Prester W.

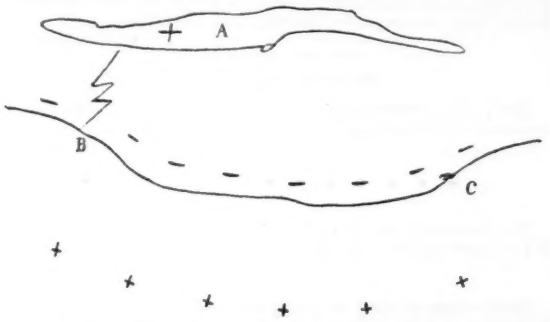
[286]—Electricity.—Which is the simplest and best text-book published on electricity and magnetism? What is the best kind of galvanic battery for strengthening the nerves; and what would be the price of same? I do not want an expensive one.—W. H.

Replies to Queries.

[249]—Abstract Reasoning.—In thirty years' reading on logic and philosophy, I never met with a distinction between "objective" and "subjective" reasoning; I am inclined, therefore, to doubt if such a distinction is generally recognised. Again, Mr. W. L. Abbot asks for a "definition of abstract reasoning." I suppose such a term might mean either (*a*) reasoning about abstract subjects, such as mathematical problems; and (*b*) reasoning about any subjects, abstract or otherwise, according to the laws of pure logic, as distinguished from analogy, and perhaps, too, "inductive" logic.—E. D. G.

[259]—Ventriloquism.—My qualification in offering explanations in this regard consists in the fact that I have long been a student of, and am the author of papers on, the subject of speech-production. The word ventriloquism means, strictly, "belly-speaking," a phrase which is really most inapt. Ventriloquism is, essentially, semi-speech. The tongue, which is the chief agent of speech, may be said to possess, practically, an interior or vertical root, and one of a posterior or horizontal character. When the tongue is drawn back abnormally upon these bases, the lower jaw and lip will be found to protrude, and to assume a fixity of condition by reason of the correlation of the muscular powers centred near the larynx. In producing speech under the above conditions the main secret of the ventriloquist's art is readily discovered. Imitation of natural sounds is effected in modulating the voice, either by contraction of the larynx or by disposition of the nasal cavities. The only real difficulty lies in mastering or modifying the lip consonants. As in all other matters, perfection is only to be gained by continual practice.—H. W.—[Answered by several others.—Ed.]

[260]—Lightning.—"Secretary" appears to have had a very good illustration of the effect of a "return stroke." When a charged body is brought near a neutral one, it has the power of polarising it. Thus, the ground immediately under a heavily-charged thunder-cloud becomes highly polarised. When the lightning passes, the neutral condition is suddenly restored, sometimes doing more mischief than the lightning. Suppose the cloud, A, to be charged



+ly, then, of course, the surface of the earth under it will become − the + electricity being repelled as far as possible from the inducing body (the cloud). When the charge in A is too great, the insulating air is pierced, and the flash passes, say to B. The cottages, C, being above the general surface, are more −ly charged than the ground, and feel the "return stroke." Tyndall's "Lessons in Electricity" will help "Secretary."—Euclid.

[268]—Photography.—Will "Anon" say what purpose he has in view, whether portrait or landscape photography, or the application of photography to some special purpose, when, as an amateur of experience, I shall be most happy to advise him. *En passant*, it is as well to remark that the practice of photography has been completely revolutionised during the last two or three years, and it is almost impossible to name any work on the subject suitable for a beginner, since the information he would need still remains squandered through the various technical publications of the last few years, not having been as yet condensed into *handbook* form.—E. T. W.

[347]—Wild Flowers.—The nearest approach to E. Taylor's requirements is Rev. C. Johns' "Flowers of the Field," 5s. (S.P.C.K.), containing a number of illustrations, as well as descriptions.—Eupteris.

Brewing.—To add to list of books on brewing:—"Brewing, Practical and Scientific," by E. R. Southby, M.R.C.S., F.C.S., published by us (*Country Brewers' Gazette*); "Brewing," by J. Herbert, Burton-on-Trent; and "The Art of Brewing" (Cornish, Holborn).—C. Dewston.

XUM

Answers to Correspondents.

**** *All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded; nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *No queries or replies savouring of the nature of advertisements can be inserted.* 4. *Letters, queries, and replies are inserted, unless contrary to Rule* 3, *free of charge.* 5. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 6. *Each letter, query, or reply should have a title, and in replying to letters or queries, reference should be made to the number of letter or query, the page on which it appears, and its title.*

S. S. Question answered at p. 94, No. 5.—R. MORTIMER. Not by me. Other matter (about probable explosions) suitable for daily papers—next time you think they are likely to occur.—TYRO ASTRONOMICUS. Subject of earth measurement not so simple as you seem to think.—SCIENCE AND ART. Fear most of our readers do not care twopence about the rules and regulations of the Science and Art Department; so can hardly find space for article showing that they "muchly need correcting."—J. MURRAY. My *dear* sir, it would take a page six times as large as ours to present your diagrams properly. The sun may expand our "atmostphier" on the one side, which gives to it a rotating motion, and "our earth approaching the sun down the decrescendo line," may be "the cause of solar time," but these profundities are not for us.—T. MACKENZIE. Thanks.—F. J. B., JOS. R. GREEN. Thanks; but those subjects already provided for.—REDDITUS. You calculate without considering interest; that might be the brokers' way, but it is quite incorrect.—ALL ROOTS. I would rather not "extract for you the fifth root of 5053632, or the eleventh root of 11, or the thirteenth root of 1·9, &c., &c." A rule can be given for such cases, but no one ever works them out otherwise than by logarithms.—J. ORMTHWAITE. I do not know "why Government did not appoint" me "Astronomer Royal"; nor can I conceive why I was not appointed to the command of the Channel Fleet. Perhaps it may have been that a special training is required for these offices, and that I have had none. Or it may be that I ought to have offered my services in one or other of those capacities. When I do, I shall expect a favourable response.—ENQUIRER. Not 8″·6, nearer 8″·88. For the calculation, try this:—Earth's equatorial radius (or say, 3,960 miles), at sun's distance, sustends 8″·88. Hence the full circumference of a circle having sun's distance as radius

$$= 3{,}960 \text{ miles} \times 360 \times 60 \times 60 \div 8{\cdot}88,$$

and earth's mean distance is equal to this distance, divided by $2 \times 3{\cdot}14159265$.—A. RISCHGITZ. Fear the geometrical proof is familiar to most mathematicians.—T. J. POTTER. Thanks.—T. R. ALLINSON. Thanks for vegetarian great men. But wait till list of carnivorous great men is published. Why do you include the notorious "eccentric" Sir Richard Phillips? Two-thirds of the names you give are of such a class that we might fill ten numbers of KNOWLEDGE with the like, if once we began.—T. WOLSTENHOLME. Thanks; but instances of animals nursing young of other species now sufficient in number.—WERNER. There is "no plane of oscillation of the earth." Cannot understand question 2.—M. M. You will have noticed the misprint 37·75 inches for 0·3775.—E. T. WHITELOW. Thanks; but Mr. Brothers has promised such papers.—J. P. SANDLANDS. I am sorry that you think you have been treated unfairly; but if you remember the rule you infringed you will see that I had reason to complain, not you. You consider that "Found Links" and my own article on "Luck," touch on religious questions; therein I am disposed to agree with you. No subject of which we treat in these pages can fail to do so. But you wish to emphasise, and I decline to *have* emphasised, the difference of view which may exist according as these matters are viewed from different standpoints. Leaving Professor Wilson to deal with "Found Links," let me illustrate my point of view from my articles on "Luck." There can be no doubt that some minds object to a consideration of that subject in which the influence of Providence is left, *ex necessitate*, out of consideration; but you are not to consider that the entire absence of any direct discussion of Providence signifies an absence of recognition, still less a denial of its effect. You wish me to say what my views are in this respect; but this I decline to do, beyond such general reference to the matter as you find in my last article on the matter, page 311. If I allowed myself this privilege, whether my views are on your side or not, I could not refuse the same privilege to others. Believe me, I have no wish to act unfairly, and I do not think I can be justly charged with so doing.—IGNORAMUS No. 1. You are right, see editorial letter on the subject in last number.—E. CLODD points out that as Prof. Tennant is dead (he died while I was abroad), letters addressed to him as suggested will probably not reach him.—C. J. C. On Sunday night, Feb. 19, at 7.43 P.M., saw a magnificent meteor, colour deep orange, path very short, leaving a trail of fire about 5°.—IGNORAMUS No. 2. If we take De Vico's estimate, the day of Venus is, as you say, very nearly of the same length as our own, and, as you also say, she certainly has no moon whose tide-raising action could have lengthened it. But the sun would raise high tides on Venus, supposing her oceans like ours. An orb's tide-raising action varies inversely as the cube of the distance. Now, roughly, Venus's distance is seventy-two hundreths of the earth's, and cubing this proportion, we find that the tide-raising action of the sun on Venus exceeds his action on the earth in the same degree that 1,000 exceeds 373. Whence it follows, that as the sun's tide-raising action on the earth is two-fifths of the moon's, his action on Venus exceeds the moon's action on the earth as 2,000 exceeds 1,865.—G. A. NEWCOMEN. Thanks. Answer a little too difficult.—DISAPPOINTED. Are we too miscellaneous or too astronomical? We can't be both, you know. However, in our last number, we were more astronomical than we have yet been or are likely to be again.—V. S. says that in most ships now the "forecastle" is under a raised deck forward, which is called the "top-gallant forecastle."—M. WELB, WEBB, or GELB? We *must* insist on the rule that letters and queries be kept separate and properly arranged for the printers, or we cannot deal with a tithe of the correspondence.—GEO. M. Not correct.—E. MORTEM. Thanks, question sufficiently answered already.—K. Thanks, picture almost too rough to give any idea of what the objects may have been.—E. W. CORY. Probably you are right in thinking that "A Constant Reader" would not find the weather prognostics for his district so often erroneous if he combined his observations with those made by others. Your letter is somewhat too long for insertion. We fear your suggested increase in the numbers of meteorological observers would only have the effect "of adding" (to use Sir Geo. Airy's expression) "millions of useless observations to the millions which already exist."—J. J. J. Some of those Planchette experiences are, I know, very singular, and very difficult to explain as phenomena illustrating the influence of imagination on corporal actions, which, nevertheless, I cannot but think they must be. I could not well open the matter for discussion here, simply because we could have no assurance of the truth of the accounts sent us. You are not to imagine that I question your statements—in fact, I have had somewhat similar experience within my own family circle.—H. A. BULLEY. Have given more than due space to moon's influence, which has been proved to be slight.—H. A. B. Lightning conductors do not act by repelling lightning, but the other way.—H. MUIRHEAD. The brain-wave theory must be put on a more scientific basis before it can be regarded as a part of knowledge. We have no experience of ethereal waves acting directly on the brain. What is the organ by which such waves affect the brain, and how are they conceived to act?—J. MACKENZIE, M.D. Nay. Admitting the abstract of an able lecture by an eminent doctor does not mean that we open the pages of KNOWLEDGE to the discussion of a medical subject. A paper sent us about vaccination, whether for or against, would be submitted to a competent medical adviser, and if regarded by him—first as sound, secondly as suitable—it would have a good chance of being admitted, if it were also short.—LESTOR FRANCIS.—If you notice, we are beginning microscopic matters—but at the beginning; presently we shall come to details. You see the difficulty of getting all in at once?—H'SETT. Your views seem near the truth, as far as at present seen, though it is not considered that evolution is necessarily advancing. We thoroughly agree with you that argument with persons unacquainted with geological evidence is utterly useless. We would insert much of your letter if our space were not so crowded. Note promise and hopes expressed in our last, however.—MARSHALL LEIGH. The manufacture of artificial wine hardly in our line.—J. A. S. We are likely to have chemical papers soon, but for your purpose the *Chemical News*, edited by Mr. Crookes, is the very thing.—J. B. DIMBLEBY. The time measurements of your association are wrong, but how can one show it? Transits do not always occur in pairs, as your society seems to think; and some of your teams (poor Venus in teams) would be very lop-sided.—JOHN GLEDSTONE. The moon can nearly always be seen in that way, in clear weather, when new. In America I have seen the unilluminated part (or rather the part not illuminated by the sun) when the moon has been nearly half full. The darker part is illuminated by earth-light. Our earth would appear as a large nearly full moon in the sky above those parts of the moon.—R. MORTIMER. Yes, your warning reached the office of KNOWLEDGE before the colliery accident; but we did not see it till afterwards, and we have no daily issue. Such warnings, to be of use, should be sent to the daily papers.—WILLIAM MILLER. We cannot answer questions through the post, nor give in KNOWLEDGE an opinion as to articles advertised therein; that is, not in reply to questions. Consider how open to abuse such a course would be.—H. H. The tides raised by

XUM

the satellites of Mars would be very slight. Singularly enough, I considered this point, but I cannot now remember where (know it was when I edited the Monthly Notices of the Astronomical Society), before the small moons were discovered.—W. WILSON, M.A. Your rejoinders, re-rejoinders, &c., remind me much of Boum, Puck, and Prince Paul, in "La Grande Duchesse." "Il doit être en train de monter," says Boum; "il traversera—et descendra—il retraversera, remontera, redescendra, reretraversera." "Reremontera," says Puck. "Redescendra," says Prince Paul. "Et cætera, et cætera," says Puck. Don't you think we may say so too? We are not likely to agree. To take your illustrative case (so good of you to treat me as you do "the duller boys in your school"), I should say the sun sets, even in a scientific treatise—not, "the earth rotating carries us out of view of the sun."—NEWTON CROSLAND. Dr. Ball ought truly to be ashamed of himself, "falling into the same egregious blunder as Sir Isaac Newton," and I, too (being "in my senses, and especially as a mathematician"), for allowing him to fall "into the old jog trot nursery error." But my "own paper on the 'Menacing Comet' is almost as absurd as Dr. Ball's discourse on the moon." One step further, and I suppose I shall be "as great an idiot" as Sir Isaac Newton himself. But, my dear sir, if we are so foolish as you say, do please notice how generous we are; we might, by aspersing Newton and trying to detract from his great reputation, seem to assert our own superiority, and get people to say of us, with Bunthorne,—

If that will not suit *them*, which would very well suit *me*,

Why, what very, very sapient men these sapient men must be! Instead of this, we are content to follow in Newton's footsteps as far as our feebler forces will take us. How happy it must make you to be able to say, "Until astronomers adopt my theory of polarity, the science of astronomy, or rather its exposition, must swarm with fallacies, contradictions, crudities, and nonsense."—Rev. H. H. HIGGINS. Many thanks. We have forwarded business part of your letter to publishers. The "absurd mistake" is, as you say, very amusing. Wallenstein was singularly fortunate; for astronomers have not hitherto seen Jupiter in Cassiopeia. Napoleon's referring to Venus, seen in the daytime, as *his* star, was scarcely less absurd, though in another way.—M. S. RIDLEY. The book was reviewed in an early number of KNOWLEDGE.—W. C. Because the stars are so far away. On the other point—emphatically, No; we will *not* discard the motto beginning, "There is no harm in making a mistake." It was one of the finest things ever said. Of course, if you choose to misunderstand it to mean that there is no harm in a mistake, left uncorrected, that is not our fault. Read it in conjunction with Faraday's remark on fixity of opinion, and you will find it contains a most useful lesson. Of course, a mistake is in itself unfortunate; but as no man can ever reach the truth without making mistakes, Liebig's saying remains true, even in its baldest sense. But equally of course, what he means is, that we should all be ready frankly to admit our mistakes. I believe, for my own part, there is no more useful scientific rule. Nay, I will go so far as to say that a mistake made by a well-known student of science, and frankly acknowledged, does at least as much to advance science as the discovery of a truth. But these short, pithy sayings, "jewels, ten words long, that on the stretched forefinger of all time sparkle for ever," are not for the prosaic mind. What do you suppose the old Greek philosopher would have said, if, in response to his "Know thyself," some one had answered, "I don't *want* to know myself; I would rather know somebody better worth knowing?"—SIR FR. B. Letter forwarded to publishers; there may be a day or two of delay. Letters addressed to editor are not opened at the office, and, in some cases, are kept a week before being opened at all.—H. A. BULLEY. Fogs like the dense London fogs are never seen where there is little smoke, so that there must be some connection between smoke and fogs of this sort. We did not notice the paragraph in the *Lancet*, but as you report it, it seems decidedly opposed to all the evidence.—W. H. H. SOAMES. I think, if you consider the matter carefully, you will see that whatever unfairness there may seem in my reply arose from your own departure from a rule which has been laid down, after very careful consideration, for the guidance of contributors and correspondents. You must know well that a very large proportion of the men of science of our time regard the account to which you refer as only a well-meant but utterly erroneous attempt to explain some of the mysteries of the universe. An astronomer like Sir George Airy says the geology may do pretty well, but "the astronomy is quite wrong"; a great geologist thinks the astronomy may be right, but the writer certainly knew little about the earth's crust; and so in every single branch of science which can be named. Again, it is certain that while they think that way, many estimable persons, and some of them scientific, too, think differently. The former may be quite wrong, and these latter right. Or you may be right in the extreme view you take, that not only is the account correct, but that it was intended to enlighten men as to scientific matters, and that we ought, therefore, to take the apparently plain statements in the account as part of our working material. But whoever may be right or wrong, or whether all are right in some degree, and all in some degree wrong, has really nothing to do with us. We simply decline to have inconsistencies asserted here, or attempts at harmonising made here. We want to get at scientific truth, by scientific research, observation, and experiment, and in no other way. If you are right, and the account which you deem plain (but many do not) is correct, it is absolutely certain that the views to which we shall be led by the, perhaps more roundabout, perhaps more direct, route of scientific inquiry, will agree with that account in the long-run. If the way really is longer, the exercise will do us all good.—A REMONSTRANT. When you wrote saying we had nothing but astronomy, you must have been trying some of the things which writers on Brain Troubles describe as causing mental hallucinations. We have before us the contents of Part IV., and we find, besides correspondence, notes, mathematics, whist, and chess, no less than thirty-two non-astronomical subjects. What can you mean?—J. HARKINSON. You tell me (I fancy I have heard it before) as bearing on the inferiority question, that "a woman may not be able to sharpen a pencil or throw a stone at a hen, but she can pack more articles into a trunk than a man can." Do you refer, in a roundabout way, to tight-lacing?—MORFIT. More fit for others than for us. What is new is not strictly true. You incorrectly define clouds as a collection of watery particles in the state of vapour, then correctly defining vapour.—P. A. FOTHERGILL. Thanks for very pleasant letter. The Petersburg problem is one of the most perplexing problems known. I believe I took the logically correct view in the old discussion; but if I were asked what I would pay for the chance, you may depend I would *not* offer what may be proved to be the just price, viz., infinity. It would be a very interesting subject for discussion.—ALDEBARAN. Putting x as the distance of the earth from sun after time t, we have

$\frac{d^2x}{dt^2} = -\frac{G}{x^2}$ where G = sun's gravity at unit of distance. Hence, multiplying by $2\frac{dx}{dt}$ and, integrating, we have $\left(\frac{dx}{dt}\right)^2 = C + \frac{2G}{x}$

Now when $x = D$ (the sun's distance), $\frac{dx}{dt} = 0$. Hence $C = -\frac{2G}{D}$, and therefore,

$$\left(\frac{dx}{dt}\right)^2 = 2G\left(\frac{1}{x} - \frac{1}{D}\right)$$

Integrating this you will find

$$t = \sqrt{\frac{D}{2G}}\left\{\sqrt{Dx - x^2} - \frac{D}{2}\operatorname{vers}^{-1}\frac{2x}{D} + C^1\right\}$$

And since when $t = 0$, $x = D$, $C^1 = \frac{D\pi}{2}$

we have then, when $x = 0$ (that is, neglecting the slight difference of time between the earth's reaching the centre and the surface of the sun)

$$t = \sqrt{\frac{D}{2G}}\,\frac{D\pi}{2}$$

If you put in this the correct values for D, G, and π, you will get a result very near Young's. You have D = 92,885,000 miles, G = 324,000 g. (Earth's radius)^2 (roughly), where g = terrestrial gravity at Earth's surface; and we must reduce all the distances to feet, put $g = 32{\cdot}2$, and then t will be given in seconds.—HALLYARD. I received your long paper, and preserved it, proposing to return it when stamps should be sent. Because, it really was too long "for any use," even if my "plan were that of the E. M., so that I might be glad of "a humble paradoxer or two to pad." You certainly did not in any way offend by discussion in 1877. By your own account I was the offender. If, indeed, I snubbed you "in a way no undergrad would stand from a don," I can assure you it was quite unintentional. Perhaps in those days I did not so well know the proper course to pursue. What I meant for good-humoured fun was mistaken for sarcasm, which is, in truth, quite out of my line. I agree with what Dickens says in one of his letters (I think), that it will not do to adopt a tone which might even be mistaken to signify, See how clever I am, and what fun everyone else. Thanks for note about the zodiacal light. I have never seen it well in England. I saw it very well in Bloomington, Indiana, in the spring of 1880. The atmosphere could not under any circumstances act as a telescope to enable you to see Venus as a crescent. More probably some atmospheric peculiarity distorted Venus into apparent crescent form.—H. R. SHAW. Many thanks. Your suggestions seem excellent.—H. WILLIAMS. Sorry any paper remained unacknowledged. We

insert your reply, rather shortened.—TOURIST. Question why Irish outside cars are so peculiar to Ireland, and when they were invented, scarcely scientific. It is noteworthy, by the way, how definitely national tastes seem often to determine favourite forms of vehicle. The outside car seems singularly appropriate to Irishmen (still more, perhaps, to Irish girls).—ED. C. TOUNE. In their present form your theories would hardly suit the pages of KNOWLEDGE.—CHARLES GROVER. Thanks, but except the greater distinctness of satellite II.'s shadow (as compared with I.'s) your note scarcely warrants insertion, now that interesting configuration is passed. We shall be glad to hear further from you, especially with reference to the great markings on Jupiter.—A. BARTHÉLEMY. Your queries are for a general literary paper, not for one whose chief object is science. Think you will have some difficulty in finding biography of Lady Austen (Cowper's friend). Biographies of Poe numerous; good sketches of George Eliot's life, &c., in the *Nineteenth Century* (last November, I think).—G. C. D. M. Astronomers know very little about the origin of rotatory motion in nebulous masses; but the general idea is that it arose somewhat as eddies arise in a stream. If two nebulous masses met under their mutual attraction, there would be a whirlpool motion, unless they met precisely full, which would be very unlikely. It is pleasant to be asked for more astronomy; but you can understand not only why I do not bring it to the front, but why I prefer to invite others to write astronomical articles. As you wish me to answer, myself, your question about variable length of day, I ask you to allow me to reserve it, hoping very soon to give an answer, illustrated as you suggest. If I insert it now as a query, I shall have a number of answers, some excellent, others, perhaps, not quite so well, and correspondents who have been at the pains to formulate a reply may not be very well pleased to see their labour wasted. The moon does not "lie on her back" at every lunation; she only does so when her path—soon after "new"—is carrying her north of the equator; for then, when a crescent, she is on the western sky as nearly above the place of the sun below the horizon as she can be in our latitudes. The configuration is pictured in my book on the "Moon."—VOLCANO. We really must not insert queries relating to medical matters in KNOWLEDGE. We have many medical men among our readers, and correspondents who would, no doubt, reply to them; but others might reply without the necessary information. Then your question is too vague; heat spots on the forehead, and why (you ask) on the forehead? If they are heat spots, cooling medicines ought, one would say, to be good.—W. GRANDY. See answer above to G. C. D. M.—SIR E. B. Phrenology would never have been suggested, I apprehend, if there were not reason for associating particular confirmation of the skull (apart from external influences) with particular mental or moral qualities. A "phrenologia sana" such as that we may admit. It is the theory that beneath the "bump" places are the cerebral organs of those affections or qualities, which is rejected by anatomists. I cannot quite agree with you that "if a single man in the world can give true judgments of character from heads, all the anatomists in the world cannot prove phrenology wrong." A hundred correct judgments would not do so much to establish phrenology (in the form in which Gall and Spurzheim advanced it) as a single failure would do to negative it. The way in which failures (you admit that most of the phrenologists failed sometimes) are explained by the advocates of that system belongs simply, as Wendell Holmes well puts it, to the system "heads I win, tails you lose."—BISHOP. Like Gilbert's "dancing man," I would answer you, "right reverend sir, in half-a-crack," if it were altogether fair; but with Browning, Dollond, Wray, and other thoroughly excellent opticians, to choose between, I could not recommend any as *the best* maker you could go to for a 3-inch telescope.—C. S. BENTLEY. Thanks. Will review if space permit. You attribute to Isaac Walton the saying about strawberries (page 338 KNOWLEDGE), referred to Cotton Mather (Walton's "Complete Angler," chap. 5, page 109, Chatto's edition, p. 114; Simpkins). They tell the story in America of Mather.

[Two columns of Answers to Correspondents crowded out.—P.D.]

NOTICE.—For "Nos. 2 and 3 are *not* out of print," in Answers to Correspondents, No. 17, read "Nos. 2 and 3 are *now* out of print." Part I. is now entirely out of print. Those who wish to complete the series would do well to get the Parts which are still in print, and to add their names to the list of applicants for Part I., so that, should any copies be returned, they may be distributed in due order.

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Letters Received.

J. Rae, Lepidodendron, answered. Also by F., H. Courtenay, W. B. K., J. M. Carr, W. D. C., Geo. Biddell, J. S. Thorne, Harvard, Colonial, J. W. Emery, T. K. Snood (?), L. Empson, J. E. T., M. Prang, E. R. T———n, Ellicott, Petersburg, Ante-Prandial, Jorkins, L. M. S., Fraulein, A. Accrington, Emeritus, Peter Parley, S. Pritchard, M. Hosking, L. Hoare, Surbiton, Tricycle, Medicus, N. Hatherley, General Lambert, M. Soper, Pro-di-gious (very), Duncan D., Professor, Baptist, L. S. P., Half-Sprung.

Notes on Art and Science.

THE language of the Seychelles is a curiously corrupt French, in some respects similar to *argot*. Thus a common expression among the natives is *Moi ne cont pas*, for *Je ne connais pas*; similarly, they frequently interpolate a medial vowel, and say *gelisser* for *glisser*, *belouse* for *blouse*, and so on. These singular linguistic peculiarities deserve the attention of philologists, for no explanation of them has yet been given, except the purely negative one that no mixed race ever retains purity of tongue; but although this axiom accounts for the existence of many mixed languages—notably our own—it does not explain how the pure French of the original aristocratic exiles became degenerated into a tongue similar to that which is popularly supposed to be spoken only at young ladies' academies and by English tourists on the Continent. —*Graphic*.

A FOG BOW BEFORE SUNRISE.—The phenomenon of the ordinary rainbow is familiar to every observer of nature. White fog bows, or "fog eaters," as they are called by sailors, are frequently visible in localities favourable for their formation; and they are generally regarded as indications of clearing weather. A fog bow was observed, writes Mr. H. C. Hovey, on the morning of Jan. 8, from my residence on Fair Haven Heights, near the estuary of the Quinnipiac River, and about 100 ft. above the sea level. No rain was noticeable in any quarter, but the valleys were filled with fog, above which the hill tops stood like islands. At exactly ten minutes before sunrise (due at 7.26 a.m.), on looking north-west I saw a brilliant arch of prismatic colours spanning the East Rock Range, the highest point of which is 350 ft. above the sea. As the sun arose, the arch diminished in height and vividness, and by the time the orb was visible in the morning sky, the fog bow had vanished.—*Scientific American*.

WARMING ROOMS.—"S. S." asks me how to warm a room 13 × 13 ft., which has no chimney or any outlet for stove-pipe. I cannot tell how to do this satisfactorily. If obliged to occupy such a room, I should economise my own animal heat by wearing a thick top-coat, double woollen socks, &c. I have warmed a small conservatory, requiring merely protection from night frosts, by burning a few common, cheap paraffin lamps, distributed so as to equalise the temperature. A gas-stove would have killed the more delicate plants; the difference is due to the fact that the mineral oil is so pure a hydro-carbon that it produces only water and carbonic acid by its combustion, while the gas contains bisulphide of carbon and other impurities, which, by their combustion, produce irritant or actively poisonous compounds, to which the plants are more sensitive than we are. If "S. S." uses such lamps, or one of the paraffin stoves sold for the purpose, he should place them on the floor, or as low as possible, in order to economise their heat. Each ordinary lamp will give him about as much heat and carbonic acid as a human companion.—W. MATTIEU WILLIAMS.

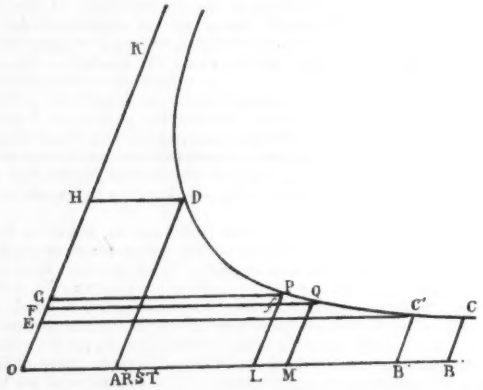
NOVEL HELIOMETERS.—At a recent meeting of the Royal Dublin Society, Mr. Howard Grubb, F.R.A.S., described some novel heliometers which are at present in process of construction in Dublin for the Belgian Government, to be used at the coming transit of Venus, the design of Professor Houzeau, the Belgian Astronomer-Royal. A heliometer is generally made from a single objective cut in two, with mechanical arrangements for traversing one-half with respect to the other. In Professor Houzeau's arrangement the two half-objectives are of very different foci—one of about 14 feet, the other 6 inches only, but so placed that both form their image on the same plane. As the apparent diameter of Venus and the sun are about as 28 to 1, it follows that the image of Venus, as formed by the large objective, will be about the same size as that of the sun formed by the small objective, and, consequently, coincidences can be made, not by bringing the limb of Venus to touch that of the sun, or a micrometer line, but by superposing the image of the sun as formed by the small objective on the very slightly larger image of Venus, as formed by the large objective, and thus it is hoped that all the inconvenient and perplexing phenomena of irradiation, "black drop," &c., will be completely eliminated. Mr. Grubb exhi-

bited several portions of the instrument, and mentioned the various difficulties likely to be encountered, and the means provided for dealing with them.

STRENGTH OF MATERIALS.—At the late fair of the Massachusetts Charitable Mechanic Association, at Boston, examples were shown of tests of materials made by the machine lately erected in the United States Government Arsenal, at Watertown, for the proving of structures of full working dimensions. A steel wire cable, $1\frac{3}{4}$ inches diameter, was shown, which had withstood a pull of 75 tons, when the fastenings by which it was held gave way, although the cable itself remained sound. A hammered iron bar, 5 inches in diameter, was shown to have concealed a crystalline formation of the fibres, and it consequently parted with a loud report under a strain of nearly 723,000 lb., or 36,900 lb. to the square inch. A smaller wrought-iron bar drew down and broke with a fibrous structure under a pull of 51,340 lb. per square inch. Some pine-wood columns were also shown which had been tested by compression. The first of these, originally 12 feet long, yielded at a pressure much below its estimated strength, in consequence of a large knot in the side, which acted as a comparatively incompressible wedge. Another column was a spar 12 feet long, $7\frac{3}{4}$ inch butt, and $6\frac{1}{2}$ inch top. This stick was a perfect sample, and gave way by splintering at its smaller end. A seasoned hard pine girder, 11 inches square and 10 feet long, bore a load of 751,000 lb. —*Scientific American.*

Our Mathematical Column.

Find the area intercepted between a hyperbola, an asymptote, and two ordinates parallel to the other asymptote.



Let OAB, OHK be the asymptotes; AD, BC drawn parallel to OK to meet the curve in D,C. In OAB take OR greater than OA, but so that AR is very small; take points S,T .... L,M ...&c., so that OA : OR::OR : OS::OS : OT.... OL : OM ...., and let B′ be the nearest of such points : to B, so that B′B is small. Suppose that OB′ is thus divided into n parts AR, RS, ST, &c. ...., and let LM be the $(r+1)$th such part. Draw LP, MQ parallel to OK to meet the hyperbola in P and Q, and draw DH, PQ, QfF, C′E parallel to OB, QF meeting PL in f. Then, since OA : OR::OR : OS::OS : OT, &c. ...., and that LM is the $(r+1)$th of the parts AR, RS, ST, &c., *i.e.*, M is the $(r+1)$th of the points : of division R,S,T, &c.

$$OA : OM :: OA^{r+1} : OR^{r+1} \qquad (i)$$

and similarly $OA : OL :: OA^{r} : OR^{r}$

$$:: OA^{r+1} : OA.OR^{r}.$$

Hence $OA : LM :: OA^{r+1} : OR^{r}.AR$

But $DA : MQ :: OM \cdot OA$ since $OA \cdot AD = OM \cdot MQ$

$$:: OR^{r+1} : OA^{r+1} \quad \text{from (i)}$$

Thus $OA.AD : LM.MQ :: OR^{r+1} : AR$

or parallelogram $OD :$ parallelogram $LA :: OR^{r+1} : AR$

i.e, all the parallelograms inscribed as LQ is are equal : thus parallelogram OD : sum of inscribed parallelograms::OR : n AR

But sum of parallelograms = ADC′B′ = ADCB ultimately, when AR is taken indefinitely small.

Hence ADCB : parallelogram OD::n. AR : OR (ii)

But ultimately $OA^{n} : OR^{n} :: OA : OB$, *i.e.* $\left(\frac{OR}{OA}\right)^{n} = \frac{OB}{OA}$ or n log. $\frac{OR}{OA}$

$$= \log. \frac{OB}{OA}$$

$$\text{Thus } n = \frac{\log. \frac{OB}{OA}}{\log. \frac{OR}{OA}} = \frac{\log. \frac{OB}{OA}}{\log. \left\{1+\frac{AR}{OA}\right\}} = \frac{\log. \frac{OB}{OA}}{\frac{AR}{OA}}$$

$$= \frac{OA}{AR} \text{ ultimately } \log. \frac{OB}{OA}$$

Hence $n \cdot AR = OA \log. \frac{OB}{OA}$, and (ii) becomes

$$ADCB : \text{parallelogram } OD :: OA \log. \frac{OB}{OA} : OR \text{ or } OA$$

since OA = OR ultimately

i.e., $ADCB = \log. \frac{OB}{OA}$ parallelogram OD.

EDITOR.

[25, p. 307]—There appears to be an error in your solution of this question. You have taken the number of months as 20, instead of 120, $£\frac{6}{5}$ for $£\frac{7}{6}$.

The following appears to be a solution :—If r = the rate of interest per cent. per month, then r has to be found from the equation—

$$\frac{1-(1+r)^{-120}}{r} \times 1{\cdot}1\dot{6} = 100.$$

$$\text{or } \frac{1-(1+r)^{-120}}{r} = 85{\cdot}7143.$$

It will be found by logarithms that ·005918 is a very near value of r in this equation. Hence £·5918, or 11s. 10d. *per cent.* per month is the rate of interest realised.—J. MCGOWAN.

[Query No. 200, p. 278]—LEASES.—W. Cahill's query in No. 15, in connection with James Gregg's previous query :—

	£	Decimals of £.
Assuming the interest to be 5 per cent., the premium of £1,050 paid at commencement would amount at the end of 14 years to	2,078	928
An annuity of £250 would amount at the end of 10 years to.....	3,144	473
The interest on same for 4 years (to end of the 14)	677	657
An annuity of £300 would amount at the end of 4 years to	1,293	038
Total value of all at end of 14 years	7,194	096
The present value of this amount being	3,633	5
Which would buy an annuity or the lease at a peppercorn rent of	367	075
Deducting the £300 rent paid each of the last 4 years, the premium to be paid at the end of 10 years is the present value of 4 years' annuity of £67·075, which amounts to.....	237	845

—J. W. *The Answer.*

Our Whist Column.

BY "FIVE OF CLUBS."

AN ILLUSTRATIVE GAME.

CLAY, in his charming little treatise on "Short Whist," gives the following interesting instance of the danger of continuing a forward game, when early indications show that the promise of a great score was fallacious. (In passing, one may note that in cases such as this information of weakness may prove exceedingly useful to the stronger partner, by showing him the necessity of caution; it is in this respect that the ordinary game differs from dummy play, when the danger is indicated at once. Some dummy players are apt to overlook this negative advantage of intimation of weakness in partner's hand, and to consider only the more obvious positive advantage which necessarily accrues to the adversaries):—

"I dealt," says Clay, "and turned up a Queen, along with which I held two small trumps. My partner—nor was he a bad player—held the Ace and four of the smallest trumps, and, so to speak, the whole of another suit. With this strength, assisted by my Queen, he promised himself, reasonably enough, a great score, if not the whole game. But the first two tricks showed him that he would be overtrumped. He should have submitted to this, and as it happened he could have made a good score, but he was unable to dismiss the idea of a strong attack. He trumped the second trick with his Ace, led a trump,—and we made no other trick. Thus with Ace, Queen,

eight trumps, five of which were in one hand, between us, we lost twelve tricks out of the thirteen."

The following game is made up to show how this might happen :—

THE HANDS.

A.
Clubs—K, 10, 9, 8.
Hearts—A, K, 10, 9, 4, 2.
Spades—10, 3, 2.
Diamonds—none.

B.
Clubs—Kn.
Hearts—Kn.
Spades—A, Q, 8, 7, 5, 4.
Diamonds—5, 4, 3, 2.

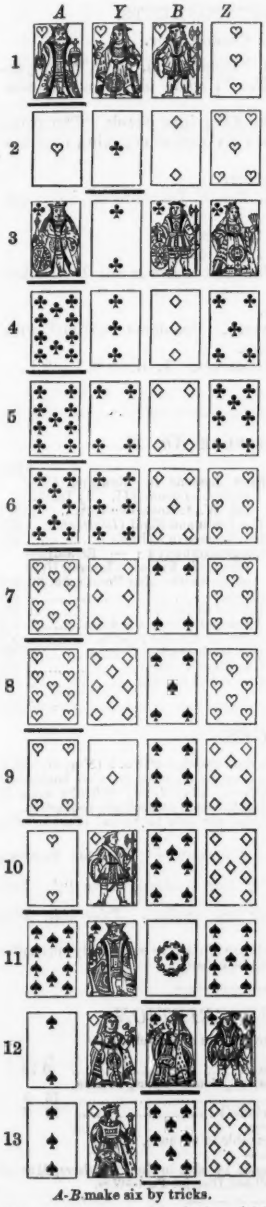
B
Dealer.
Y Z
Trump Card, Queen of Clubs.
A

Y.
Clubs—A, 6, 4, 3, 2.
Hearts—Q.
Spades—K.
Diamonds—A, K, Q, Kn, 8, 6

Z.
Clubs—Q, 7, 5.
Hearts—8, 7, 6, 5, 3.
Spades—Kn, 9.
Diamonds—10, 9, 7.

Score :—Love all.

NOTE.—The underlined card wins trick, and card below it leads next.



A-B make six by tricks.

REMARKS AND INFERENCES.

1.—*Y* knows that *B* is not playing a false card in his (*B's*) partner's suit, so that *B* will be able (probably) to over-trump second round.

2.—*A*, of course, continues his suit. If he did not know that *B* can trump the suit, he would not force the adversary, being himself strong in trumps. His play should suggest to *Y* that *A* is strong in trumps, and he should give up the line of play he had intended to follow. He must yield to the force; if he declines, he will be forced again next round, and must either yield then under less favourable conditions, or let *Z* ruff, who must be weak in trumps. It is better to throw the lead at once into *Z's* hand. If he had done this, *Z* would have made the second trick with trump, have played the Ace of Spades, and then forced *Y* with the Queen. *Y* might then have led Diamonds, in order to force *A* (which, as it happens, would come off in the first round) leaving *A* either to lead trumps under unfavourable conditions, or to force *Y*, which *Y* could accept, being able to force back with his Diamonds, when *Z* would be left with length in trumps. As it is, *Y*, after throwing away the commanding card in trumps, is absolutely powerless.

3.—The rest of the hand plays itself. *Y's* discard of the Diamond Ace at trick 9 is intended to show his partner that *Y* has entire command of the Diamond suit, but *Y* gets no chance of leading Diamonds or any other suit.

HE THAT WILL NOT WHEN HE MAY, &c.—The following singular combination of cards is worth recording, as it may be made to point a moral. It came under my observation at the Portland, Clay and my father being partners. The game was four-all. The dealer turned up a small heart. Clay led a Diamond. The second hand had Ace, King, Queen, Knave, ten, nine, and two, of trumps. With these cards, the problem is how to lose the odd trick.

The second hand contrived it in this way. He had no Diamond, and trumped the card led, with the deuce of Hearts. My father (third hand) also had no Diamond, and only one trump, the three with which he overtrumped. In the end, the holder of the sixième major only made his six trumps, his adversaries having six winning cards in the unplayed suits, which neither of the opponents could trump. They therefore lost the odd trick and the game. Had the second player (*B*) trumped with the nine originally, he must have won the game, however the cards lay. For, his partner being dealer, held the trump card, and consequently *B*, by then leading trumps, must make seven tricks, even if all the remaining trumps are in one hand against him. No doubt *B* regarded the chance of the third hand's having none of the suit in which he himself was void as practically *nil*. Nevertheless, he might have made the game practically sure.

The moral is: Never throw a chance away.

"CARD TABLE TALK," "CAVENDISH."

ALL THE TRUMPS IN ONE HAND.—A correspondent (J. Heaton, Surrey) asks what are the odds against all the trumps falling in the dealer's hands, and whether it has ever happened. Two cases were recorded a few years ago in the *Westminster Papers* (we will look the case up), and the editor made the remark that this showed mathematicians to be wrong in stating that the odds were, in round numbers, 159 thousand millions to one against such an occurrence. We cannot see it. It would not be very much out of the way to suppose that among all the whist-playing nations of the earth a million whist-parties play per diem; and, say that in each case there are twenty deals. Then it would require only 7,950 days, or not much more than 20 years, to give 159,000,000,000 trials, which, of course, would give an even chance that any particular hand would be turned up once at least. [This is not quite correct, there are two possible results in tossing a coin, but it does not require two trials to give an even chance of tossing head once at least. Evidently my papers on chance should soon be started. Let me note that the exact odds against the dealer having thirteen trumps are

158,753,389,899 to 1.

Pretty long odds.—ED.] The odds against the occurrence must, we should think, be diminished by the circumstance that when a ruffing game has been played, there are several cards of the same suit arranged one in each of several sets of four cards, after tricks are gathered. Supposing them to occupy the same position in each set, which might readily happen, that there is very little shuffling, and that the same suit is trumps in the next hand, it will easily be seen that four or five trumps might be already *en train* to fall to dealer, so that the chance of the remaining trumps falling to him alone would have to be considered. [Say the chance of this happening in the case of five trumps, besides the turn-up card were only 1-1,000. There are thus 20 cards disposed of in the five tricks supposed to have come together, in this special manner, in dealing. There remain 32 cards, one of which is the turn-up. Out of the 31 cards, 7 are trumps, and form one set of 7 out of

$$\frac{31 \cdot 30 \cdot 29 \cdot 28 \cdot 27 \cdot 26 \cdot 25}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7}$$

possible sets of 7, or 2,629,575. Hence the chance of both events coming off and all 13 trumps falling into one hand is one-2,629,575,000th, or the odds only 2,629,574,999 to 1 against the event.—ED.]

FIVE OF CLUBS.

A CORRESPONDENT ('Why') asks whether certain whist rules presented in doggrel rhyme are sound as far as they go. "They appeared in *London Society*, he says, some time ago, and were said to have been copied from some provincial club wall." They are Pole's, and are sound as general rules. But scarce one of them may not on special occasions be departed from with advantage. Supposing, for example, you want the odd trick to win, and have five small trumps, viz., one four-card weak suit and two suits of two cards each. It would be absurd in this case to follow Pole's rule respecting trumps—"When you hold five" 'tis always right to lead them.

FIVE OF CLUBS.

J. TOMLINSON.—Surely by not leading trumps when he gets the chance, *Z* shows unmistakably that he has not been wanting trumps led, and therefore he has not signalled.

GRADATIM.—Yes: from Ace, six others in trumps lead Ace. The lead of Queen from Queen, Knave, nine, and others (three others you specify) is now generally rejected. Hoyle advised it, with the object of finessing the nine, on the return of the lead. This might do in long whist, but not in the game as now played.

FIVE OF CLUBS.

W. F.—In Problem I. *B* leads trumps fourth round, because his partner, not knowing what *B* knows, would be at a loss how to play after making the successful finesse in Diamonds. If he continued the Diamond lead, *B* would have to lead from his tenace in Hearts. The lead of trumps manifestly puts *Y* at a disadvantage. He must

lead either through *B's* tenace in Hearts, or up to *A's* tenace in Clubs. He also, as you say, requires information about honours.

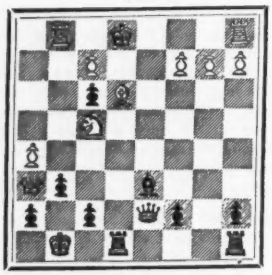
A STRANGE RETURN LEAD.—*Y* leads a small card, which *B* (second hand with Ace, King, Knave) wins with Knave, and immediately returns King, which *A* (*B's* partner) trumps. At the end of the hand *B* has the effrontery to ask *A why* he trumped his King. Might not *A* have retorted with more reason, why did you put on Knave? —W. F. With much better reason. *B* said, as plainly as whist language can speak, "I hold the King only, and play it so that, if you have the Ace, you may save it." But why did you head your letter "an omitted case where Ace should be led before King"—this is a return lead, and I have considered no return leads at present.

FIVE OF CLUBS.

Our Chess Column.

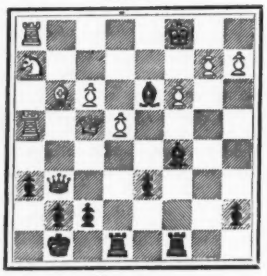
Endings from actual games played by Mephisto:—

No. 23.
AMATEUR.
WHITE.



BLACK.
MEPHISTO.

No. 24.
AMATEUR.
WHITE.



BLACK.
MEPHISTO.

Mephisto won as follows:—

	B. to Kt.5(ch.).
P. to B.3 (a).	Q.R. to Q.sq.
Kt. to K.2 (b).	Q. to Q.6.
Kt. to Q.4.	R. takes Kt.
Resigns.	

(a) If K. to B.sq., then Q.R. to Q.sq. Now, if Kt. to Q.3., Q. to R.6 wins; or, R. to K.sq., Q. to Kt.4(ch)., Kt. to Q.3. R. takes Kt., wins.

(b) Black threatens—

	K. to B.sq.
Q. to Q.7(ch).	Q. to Q.8(ch).
R. takes Q.	
R. takes R., mate.	

	Q. takes B.
Q. takes Q. (a)	B. to K.6(ch).
K. to Q.sq.	Q.R. takes B.P.
P. takes R. (b)	R. to Kt.sq.
Resigns.	

(a) Had Amateur seen his danger, and not taken the Queen, then Mephisto would win by being a piece ahead.

(b) This was unexpected; he must take the Rook.

SOLUTION.

PROBLEM No. 17. End Game by B. Horwitz, p. 330.

1. Kt. takes B.P. — P. takes Kt.
2. P. to Kt. 6. — Q. to Kt.2. (a)
3. K. to Q.7. — K. to Kt.sq. (a)
3. K. to K.6. — Q. to R.sq., or K. to R.sq.
4. B. takes P. and wins.

(a) If Q. to Kt.sq., B. takes P., wins.

CHESS BY CORRESPONDENCE.

Mr. M. J. Harding has set the ball rolling. Having at his request inserted a notice to play by correspondence in No. 16, we have received about a score of replies, and, as "our true intent is all for your delight," we shall continue to introduce the players to each other, for the benefit of Chess and of the State revenue. Letters received from—

A. B. Palmer	G. Woodcock
H. T. Holden	R. G. Brothers
A. Woverton	A. F. Baker
"Fusee"	W. G. Jones
Chas. W. Tilbe	H. Percival
G. Priestman	R. S. Tulloch

whom we have paired in the above order.

Of course, we cannot be held responsible for introducing the Lamb to the Lion, as we do not know the strength of our correspondents. Should, however, two Lions meet, and a good game or position result, we shall be happy to publish the same.

We make a beginning this week, and publish the moves of two games between Chief Editor and Chess Editor.

Remove Black's King's Bishop's Pawn. Pawn and two moves.

GAME I.

CHIEF EDITOR.	CHESS EDITOR.
1. P. to K.4. 2. P. to Q.4. 3. P. to K.B.4.	2. P. to K.3.

GAME II.

1. P. to K. 4. 2. P. to K.B.4. 3. P. to Q.Kt.3.	2. P. to K.3.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess-Editor.*

Postcard.—We know Staunton's "Companion, 1849," but you cannot call that a "modern treatise"; some of its merits have been "improved away."

J. F. B.—You must not move your King into check. The principle is, that the player who captures his opponent's King first has won the game.

G. W.—Remark about ending correct.

H. Percival.—The games in the Berlin Tournament have not "all" been published.

Henry Planck.—Solution of No. 20 correct.

R. S. Standen.—Solution of No. 14 correct.

L. E. Whitely.—Problem 20. The first move is not 1. R. takes R.P., but 1. B. to R.4(ch.).

A. B. Palmer.—Solutions correct.

Leanard P. Rees.—Solutions correct. Problems received with thanks, and will receive our attention.

G. Priestman.—Problem No. 21 incorrect. 1. B. to R.4 (ch.).

D. Cudmore.—Solutions correct.

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